ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION

OCTOBER 14, 1948

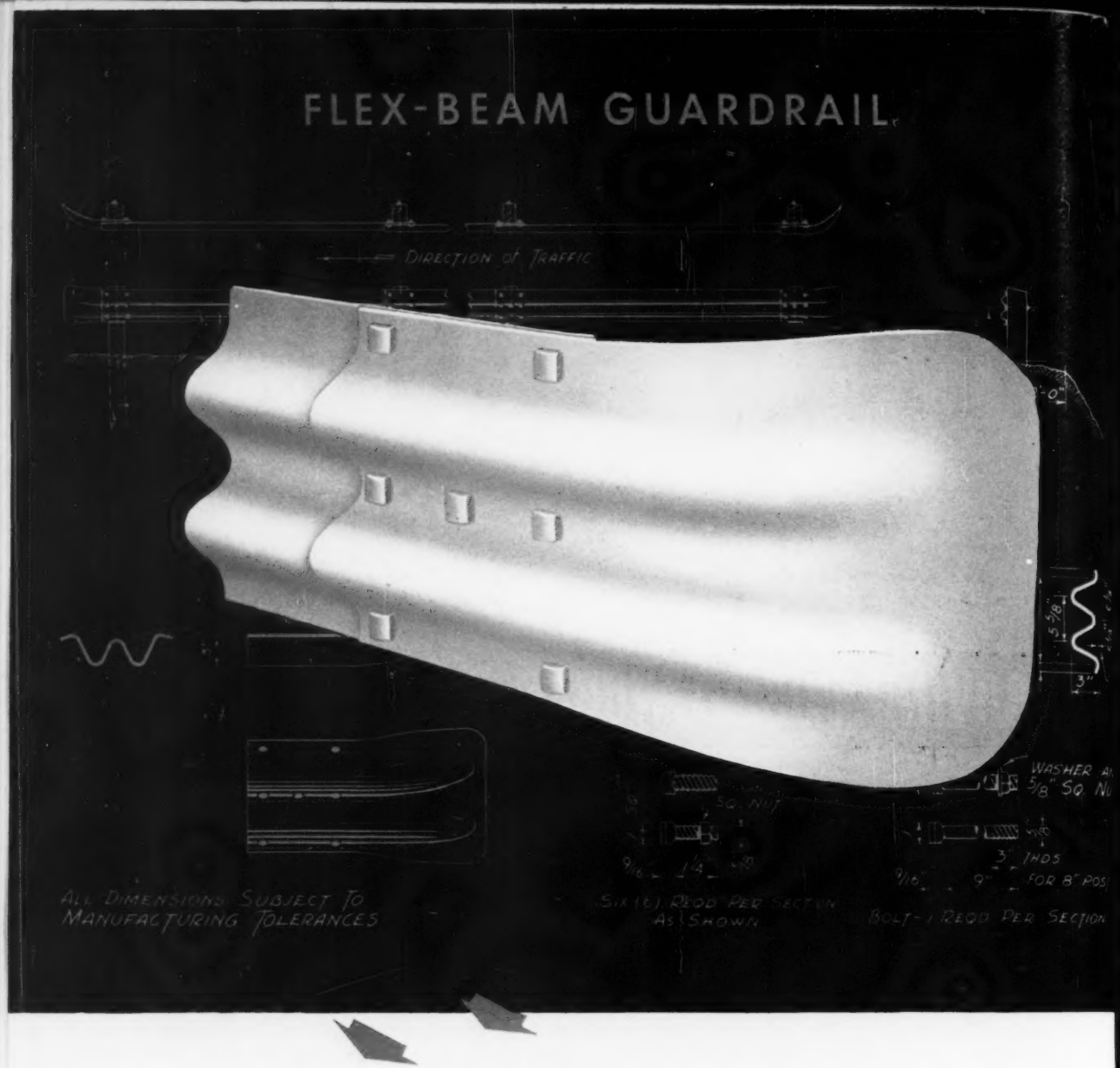
IMPROVING PUBLIC WORKS PRACTICE

Articles OF SIGNIFICANCE FOR MUNICIPAL and SANITARY ENGINEERS on...

- ★ Estimating Sewage Plant Construction Costs
- ★ Safety Essentials in a Water-Softening Plant
- ★ Timing and Teamwork in Snow Removal
- ★ Incinerator Design and Bidding Procedures
- ★ Applying the Proper Formula for Sewer Sizes

Including a survey on...

UNDERGROUND FACTORY EXPERIENCES


FLEX-BEAM GUARDRAIL
DIRECTION OF TRAFFIC
ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES
SIX (6) REQD PER SECTION AS SHOWN
BOLT - 1 REQD PER SECTION

Blueprint for safety

We put this safety specification on paper to show you why it works so well in actual practice.

Every detail of FLEX-BEAM Guardrail is designed for greater highway safety. No wonder it promotes driver confidence, encourages safer driving, and guards against injury and loss of life. All the strength is in the rail. FLEX-BEAM is tough and yet has a resiliency that cushions the impact. Extra deep corrugations lend it exceptional beam strength, and heat treated bolts assure positive splices. There is no dangerous pocketing and the continuous sliding surface automatically deflects a striking vehicle and guides it parallel with the road.

Providing better products to meet specific needs has been standard practice at Armco for more than 40 years. A few examples are HEL-COR Perforated Pipe, STEELOX Buildings, Pipe-Arches and sturdy MULTI PLATE Bridges. Today Armco engineers are backed by long experience, extensive research facilities and a real interest in helping solve drainage and construction problems.

These are some of the reasons why you should bring your problems to Armco. Here you will find a complete range of engineered products and convenient, authoritative data in every field—highway, railway, municipal and industrial. If your problem is unusual, why not talk it over with one of our specialized Armco engineers.

ARMCO

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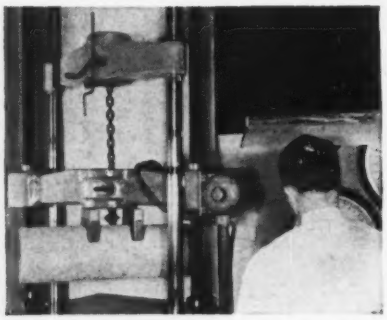
Engineering Facts about

Johns-Manville TRANSITE PRESSURE PIPE

Tapping for Service Connections

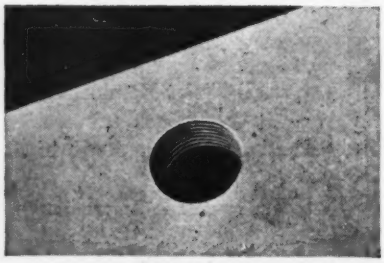
One of the many practical features of Transite* Pressure Pipe is the ease with which it may be tapped for service connections. Proof of this is evident in the hundreds of thousands of corporation stops which, over the years, have been inserted in Transite water mains. Year after year, these installations continue to serve their communities with efficiency and economy.



Laboratory tests demonstrate the strength of service connections made in Transite Pressure Pipe. In a recent series of such tests made on 8" Class 150 pipe, it required an average force of 4360 pounds to pull a ¾" corporation stop from the pipe.

Transite Pipe can be tapped wet or dry; standard tapping machines are used. The special asbestos-cement composition which gives Transite its toughness and durability also provides excellent threading properties. The threads are sharp, clean and strong. Service connections are tight and lasting.

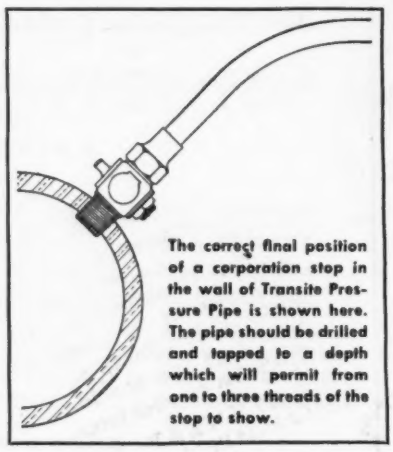
To facilitate tapping and insertion of the corporation stop, the use of a lubricant such as graphite and oil on the tap and the threads of the stop is recommended.



As this photograph shows, Transite Pipe takes clean, sharp threads. Strong and firm, these provide perfect seating for the threads of the corporation stop, assuring a watertight service connection.

Taps may be made with either Corporation Stop threads or Iron Pipe threads. While the standard combined drills and taps may be used, special alloy ones have been developed and are available from leading manufacturers. Field experience shows that these special drills and taps remain sharp after prolonged use and are more economical than standard tools.

As is true with any tapped connection, maximum strength is obtained by engaging the greatest possible number of threads of the corporation stop in the pipe wall. With Transite Pipe, this means that after the pipe wall has been properly drilled and tapped and the corporation stop fully inserted, from one to three threads of the stop will show.



The correct final position of a corporation stop in the wall of Transite Pressure Pipe is shown here. The pipe should be drilled and tapped to a depth which will permit from one to three threads of the stop to show.

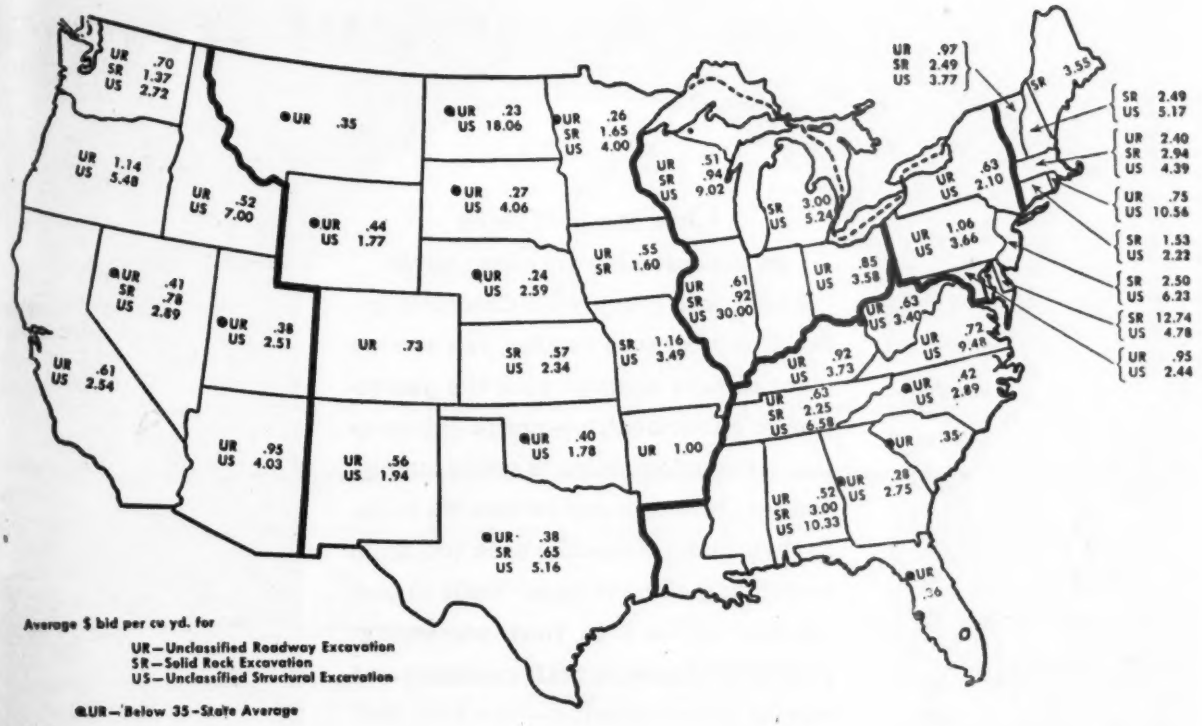
Transite Pressure Pipe is readily tapped with standard tapping equipment. Here the combination drill and tap is about to be inserted in the tapping machine.

Additional engineering data relating to service connections will appear in a future advertisement in this series. For further information, address Johns-Manville, Box 290, New York 16, N. Y.

*Reg. U. S. Pat. Off.

JOHNS-MANVILLE JM PRODUCTS

CONSTRUCTION TRENDS



Excavation Prices Vary Widely

In the second quarter of 1948, excavation bid prices for unclassified structural excavation on highway construction projects utilizing federal-aid highway funds averaged approximately 17 percent above the preceding quarter, according to prices compiled by the Public Roads Administration. Average bid prices rose to $4.03 in the second quarter from an average of $3.45 per cu. yd. in the first quarter of this year. Unclassified roadway excavation prices rose 2 percent from 45¢ to 46¢, while solid rock excavation prices declined 29 percent from $1.55 to $1.10.

Bid Price Ranges

The bid prices showed a wide range for the United States, with four states in each classification reporting prices over double the respective U. S. averages. Unclassified roadway excavation prices ranged from 23¢ per cu. yd. in North Dakota to $2.40 in Massachusetts. This range was practically unchanged from the range established for the first quarter of 1948. The four states where prices averaged $1.00 and over were Arkansas, Oregon, Pennsylvania and Massachusetts.

Prices bid for solid rock excavation showed a range of 57¢ per cu. yd. in Kansas to $12.74 in Delaware. This was a substantial increase over the range of 71¢ to $7.00 per cu. yd. recorded in the first quarter. Maine, Alabama, Michigan and Delaware were the states which reported prices of $3.00 and over in the April-June period.

Unclassified structural excavation prices ranged from a low of $1.77 in Wyoming to $30.00 in Illinois. Comparable low-high bid prices in the first quarter of this year were $1.76 and $14.00 per cu. yd. Prices of over $10.00 were reported in Rhode Island, Alabama, Illinois and North Dakota.

Prices Below U. S. Average

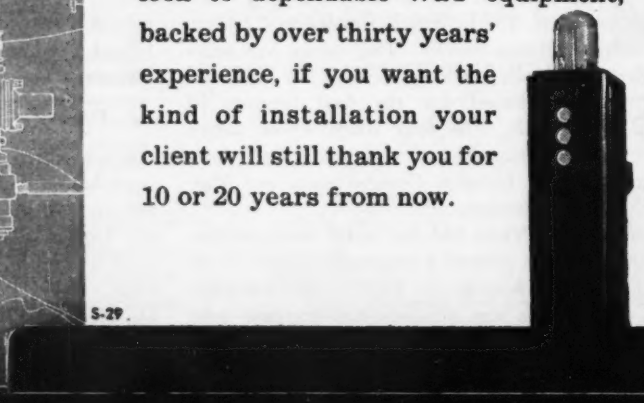
Unclassified roadway bid prices were below the U. S. average of 46¢ per cu. yd. in 14 of the 35 states in the United States where bid prices were available. Prices in North Dakota, Nebraska, Minnesota, South Dakota and Georgia averaged from 23¢ to 28¢ per cu. yd. Prices in South Carolina, Montana, Florida, Texas and Utah averaged from 35¢ to 38¢ and prices in Oklahoma, Nevada, North Carolina and Wyoming from 40¢ to 44¢ per cu. yd.

Bid prices for solid rock excavation were below the U. S. average in 5 of the 19 states reporting prices, and in 21 out of 38 states reporting prices for unclassified structural excavation.

You can't see the most important item

QUALITY isn't listed on the assembly drawing; but it *is* built into every W&T Chlorinator. It's there because neither you nor we want to take chances with the protection of public health—one of chlorination's important roles in water supply, sewage treatment and swimming pools. In their many industrial uses, too, from controlling slime in paper mills to preventing spoilage in food processing, you'll find this same craftsmanship and careful manufacturing—the kind that keep W&T chlorinators on the job economically year after year.

So when chlorination is indicated look to dependable W&T equipment, backed by over thirty years' experience, if you want the kind of installation your client will still thank you for 10 or 20 years from now.



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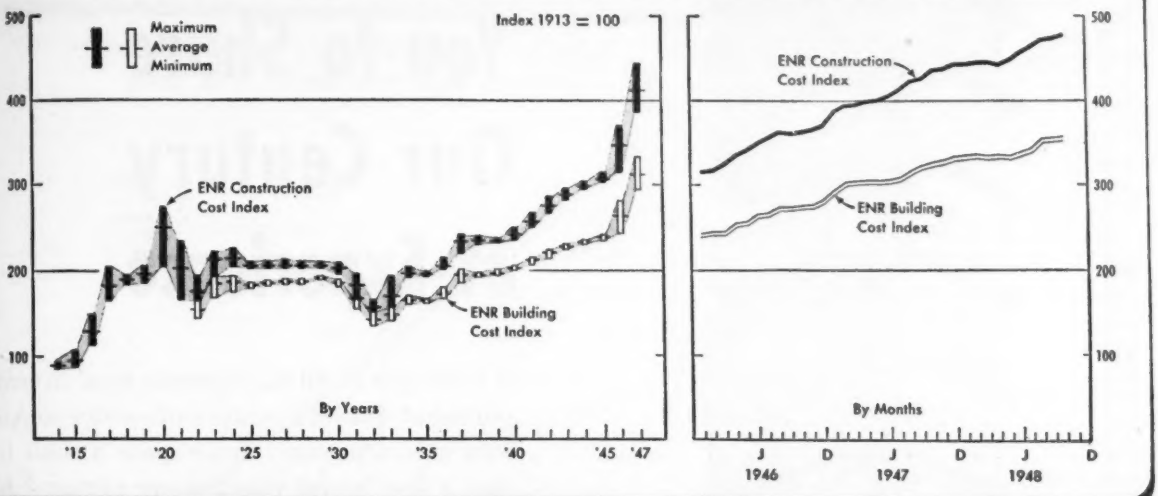
OCTOBER CONSTRUCTION BUSINESS REPORT

ENGINEERING NEWS-RECORD CONSTRUCTION AND BUILDING COST INDEX TRENDS



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	September 1947 (4 wk.)	September 1948 (5 wk.)	% Change*	Nine Months 1947 (39 wk.)	Nine Months 1948 (40 wk.)	% Change*
Total U. S. Construction	$494,805	$665,417	+8	$4,106,402	$5,276,297+	+25
Private Construction	301,785	304,631	−19	2,320,313	2,519,511+	+6
Public Construction	193,020	360,786	+50	1,786,089	2,756,786	+50
Federal	40,041	77,803	+55	493,114	757,412	+50
E N R Construction Volume Index, 1913 = 100	250	240	−4	225	250	+11
Total New Productive Capital	$150,578	$220,881	+17	$2,518,971	$5,080,187	+97
Private Investment	150,578	220,881	+17	1,452,531	3,028,966	+103
Federal (non-federal work)	.....	.....	.....	247,711	492,289	+99
Federal (federal work)	.....	.....	.....	818,729	1,558,932	+90

* *Adjusted for difference in the number of weeks reported.*
† *Adjusted to include an additional $3,500,000 in Aug.*

CONSTRUCTION COST . . . . WAGE RATES . . . . MATERIAL PRICES

1913 = 100	October 1947	October 1948	% Change	Change September to October 1947 Sept.	1947 Oct.	1947 %	Change September to October 1948 Sept.	1948 Oct.	1948 %
E N R Constr. Cost Index†	434.58	480.21	+10.50	426.38	434.58	+1.92	478.40*	480.21	+0.38
E N R Building Cost Index†	327.29	357.07	+9.10	322.58	327.29	+1.46	356.70	357.07	+0.10

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*
* *Revised.*

ENR 20-CITIES' AVERAGE

Common Labor	$1.263	$1.413	+11.88	$1.237	$1.263	+2.10	$1.401*	$1.413	+0.86
Skilled Labor (Av. 3 Trades)	2.125	2.332	+9.74	2.100	2.125	+1.19	2.318	2.332	+0.60
Bricklayers	2.271	2.529	+11.36	2.246	2.271	+1.11	2.516	2.529	+0.52
Structural Ironworkers	2.139	2.315	+8.23	2.117	2.139	+1.04	2.303	2.315	+0.52
Carpenters	1.963	2.177	+10.90	1.938	1.963	+1.29	2.158	2.177	+0.88
Cement, bulk, per barrel	2.63	2.95	+12.17	2.63	2.63	0.0	2.94	2.95	+0.34
Structural Steel, base	2.80	3.25	+16.07	2.80	2.80	0.0	3.25	3.25	0.0
Sand, per ton	1.814	2.042	+12.57	1.814	1.814	0.0	2.035	2.042	+0.34
Lumber, 2x4 Fir, per M ft.	92.62	98.82	+6.69	90.32	92.62	+2.55	99.12	98.82	−0.30
Lumber, 2x4 Pine, per M ft.	84.74	84.68	−0.07	81.64	84.74	+3.80	85.23	84.68	−0.65
Common brick, per M	23.713	27.213	+14.76	23.538	23.713	+0.74	26.963	27.213	+0.93
Ready-mixed concrete, c.y.	9.261	10.140	+9.49	9.187	9.261	+0.81	10.119*	10.140	+0.21
Struct. clay tile, 3x12x12	119.96	126.94	+5.82	119.58	119.96	+0.32	126.87	126.94	+0.06

* *Revised.*

MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	September 1947	September 1948	% Change	August 1948	% Change Aug. to Sept.
Steel (% operating Capacity) A.I.S.I., weekly average	90.1	95.7	+6.2	94.6	+1.2

	June 1947	June 1948	% Change	Six Months 1947	Six Months 1948	% Change
Cement, thous. bbl. U.S.B. of Mines	18,179	21,426	+17.9	77,883	91,517	+17.5

	August 1947	August 1948	% Change	Eight Months 1947	Eight Months 1948	% Change
Fabricated Structural Steel, tons, A.I.S.C.	157,952	163,369	+3.4	1,206,692	1,285,117	+6.5
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	$289,824	$377,081	+30.1	$1,496,516	$1,667,198	+11.1

COST OF LIVING INDEX . . . . EMPLOYMENT

Base 1935–39 = 100	1941	August 1947	August 1948	% Change	July 1948	% Change July to Aug.
Consumers' Price Index, B L S	105.2	160.3	174.5	+8.9	173.7	+0.5
Rent (Housing) Index, B L S	106.2	111.2	117.7	+5.8	117.3	+0.3

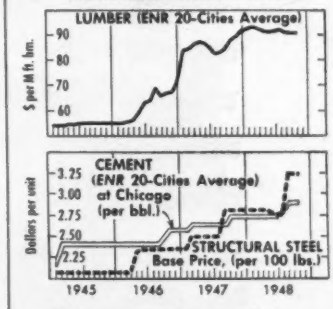
	August 1947	August 1948	% Change	July 1948	% Change July to Aug.
Contract Constr. Employ. (est.), thous., B L S	2,096	2,250	+7.3	2,217	+1.5

ENR INDEX NUMBERS

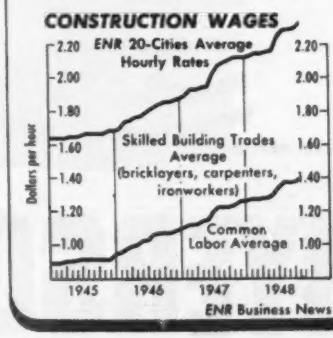
Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Oct., 1948	480.21	230.84	357.07	193.02	.....	.....
Sept., 1948	478.40*	229.97*	356.70	192.82	240	105
Aug., 1948	477.11*	229.35*	355.45	192.15	255*	112
July, 1948	464.83*	223.44*	342.42	185.10	265*	116*
June, 1948	455.80	219.10	339.26	183.39	282	124
May, 1948	444.86*	213.84*	333.93	180.51	259*	114*
Apr., 1948	443.64	213.26	334.56	180.85	302	132
Mar., 1948	443.60	213.24	334.22	180.67	247	108
Feb., 1948	442.67	212.79	335.49	181.36	231	101
Jan., 1948	441.65	212.30	333.58	180.32	173	76
Dec., 1947	441.13	212.05	333.06	180.04	246	108
Nov., 1947	436.91	210.02	329.22	177.97	234	103
1947 (Av.)	413.16	198.61	312.96	169.18	228	100
1946 (Av.)	346.04	166.34	262.35	141.82	248	109
1945 (Av.)	307.75	147.93	239.14	129.27	123	54
1944 (Av.)	298.72	143.59	234.73	126.89	96	42

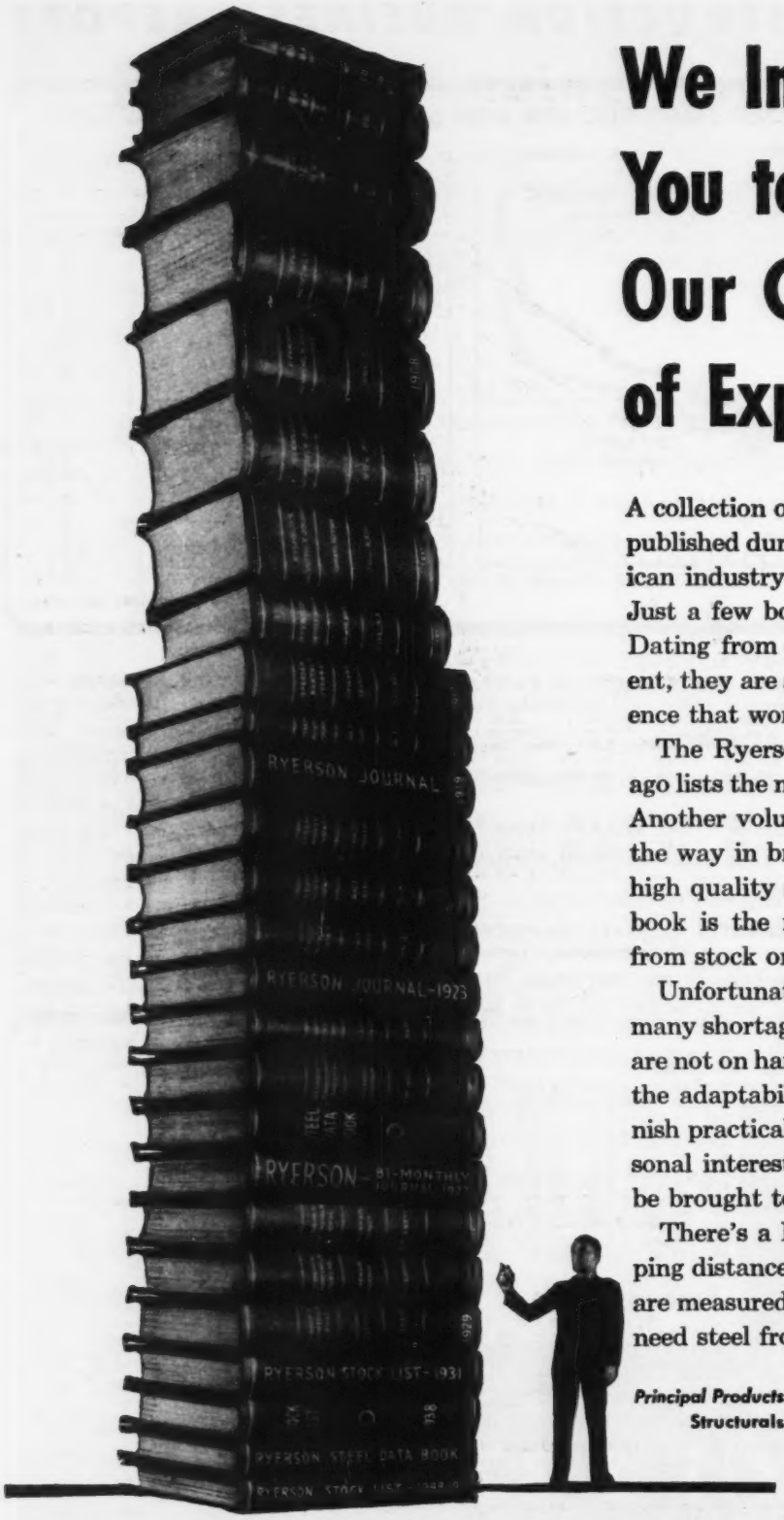
* *Revised due to common wage rate adjustment.*

MATERIAL COST PRICES



CONSTRUCTION WAGES





We Invite You to Share Our Century of Experience

A collection of all the Ryerson steel literature published during a century of service to American industry would make quite a shelf load. Just a few bound volumes are pictured here. Dating from pre-Civil War days to the present, they are solid evidence of the steel experience that works for you at Ryerson.

The Ryerson Journal of a quarter century ago lists the nation's first stainless steel stocks. Another volume is evidence that Ryerson led the way in bringing carbon steel stocks up to high quality standards. And in a more recent book is the first plan for buying alloy steel from stock on the basis of hardenability.

Unfortunately, current demand is causing many shortages. But when your requirements are not on hand, Ryerson specialists who know the adaptability of every steel can often furnish practical alternates. Certainly great personal interest and volumes of experience will be brought to bear on your problem.

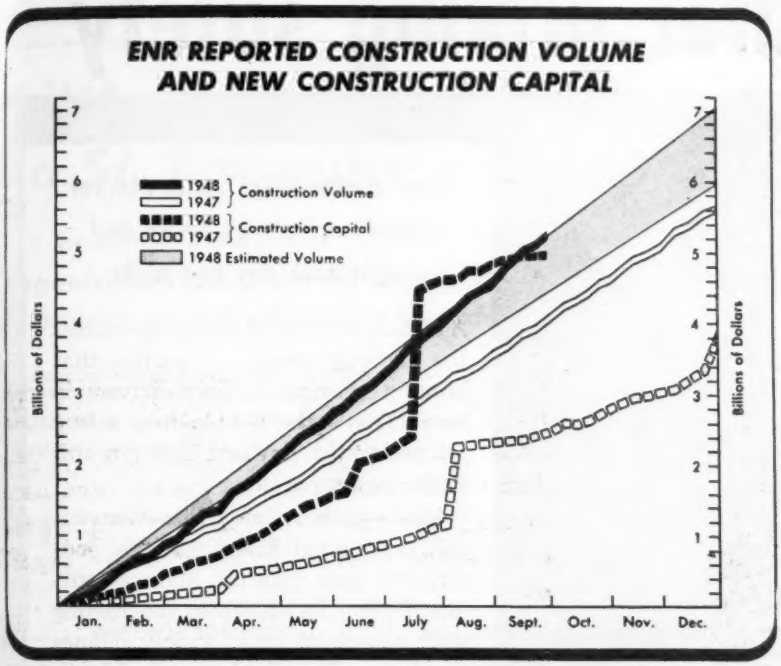
There's a Ryerson plant within short shipping distance. So, whether your requirements are measured in pounds or tons, call when you need steel from stock.

Principal Products: **Carbon, Alloy and Stainless Steels—Bars, Structurals, Plates, Sheets, Tubing, Reinforcing, Machinery and Tools**

RYERSON STEEL

Joseph T. Ryerson & Son, Inc. Service Plants: New York, Boston, Philadelphia, Detroit, Cincinnati, Cleveland, Pittsburgh, Buffalo, Chicago, Milwaukee, St. Louis, Los Angeles, San Francisco.

New Construction Volume in September


ENR REPORTED CONSTRUCTION VOLUME
AND NEW CONSTRUCTION CAPITAL
1948 } Construction Volume
1947 }
1948 } Construction Capital
1947 }
1948 Estimated Volume
Billions of Dollars
Billions of Dollars
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Civil engineering construction volume in continental United States totals $665,417,000 for September, an average of $133,083,000 for each of the five weeks of the month. This average is 6 percent below the weekly average, for August, 1948 but 8 percent above the average for September, 1947, according to *Engineering News-Record.*

The cumulative total of $5,276,297,000 for the first 9 months of 1948 is 28 percent above the 9-months total last year. On a weekly average basis, however, the cumulative total through September, a 40-week period, is 25 percent above the corresponding 9 months, 39-week period, last year.

Private construction for September on a weekly average basis is 5 percent above last month and 19 percent below September, 1947. Public construction is 13 percent below last month but 50 percent above last September. State and municipal construction is 11 percent below last month but 48 percent above the average for September, 1947. Federal construction is 20 percent below last month and 55 percent greater than September, 1947.

Weekly averages in the various classes of construction for September, 1948 compared with August, 1948 show gains in commercial buildings of 29 percent, waterways of 14 percent, public unclassified of 8 percent, public buildings of 7 percent, industrial buildings of 2 percent. Losses are recorded for bridges of 16 percent, highways of 22 percent, private unclassified of 50 percent, sewerage of 51 percent, and earthwork and drainage of 83 percent.

Geographically, the Southern section showed a gain in September, 1948 over August, 1948 of 17 percent, the Far West of 8 percent, West of the Mississippi of 2 percent, New England of 2 percent. The Middle Atlantic section dropped 14 percent and Middle West 34 percent.

New capital for construction for the five weeks of September, 1948 totals $220,881,000, or a weekly average of $44,176,000 for the month. The weekly average is thus 59 percent below the weekly average of $107,778,000 for August, 1948, revised to include the $87,000,000 bonds for the Pennsylvania Turnpike and $80,000,000 for public utilities.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED TO ENGINEERING NEWS-RECORD

Engineering News-Record *reports continental U.S. Construction projects of the following minimum costs-Waterworks, excavation, drainage and irrigation,* $ 28,000, *other public works* $ 50,000, *industrial buildings,* $ 68,000, *other buildings,* $ 250,000

Thousands of Dollars (000 Omitted)

	September, 1948						U.S. Cumulative			
Public Work	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	Total U.S.	Nine Months 1948	Nine Months 1947	% Change '47 to '48	Canada Sept. '48
Waterworks	631	419	927	3,204	14,365	10,242	29,788	161,400	82,174	+ 96	848
Sewerage	713	1,994	1,176	2,456	3,732	5,645	15,716	169,156	103,963	+ 63	722
Bridges, public	1,892	5,297	4,145	3,611	5,732	2,001	22,678	218,045	131,540	+ 66	50
Earthwork and waterways	818	3,963	14,235	1,618	24,150	6,836	51,620	402,530	231,204	+ 74	2,046
Street and roads	2,430	27,350	20,765	16,169	24,685	9,744	101,143	800,545	609,727	+ 31	1,894
Buildings, public	24,895	16,612	23,659	8,231	22,281	15,899	111,577	826,098	430,085	+ 92	31,939
Unclassified, public	1,225	7,819	3,096	3,503	4,762	7,859	28,264	179,012	197,396	- 9	9,219
Total public	32,604	63,454	68,003	38,792	99,707	58,226	360,786	2,756,786	1,786,089	+ 54	46,718
Federal government (included in above classifications)	1,750	4,898	23,154	1,264	35,022	11,715	77,803	757,412	493,114	+ 54	.....
Private											
Bridges, private	.....	3,547	.....	.....	.....	.....	3,547	6,032	824	+632	.....
Industrial buildings	3,089	15,150	11,128	14,523	38,182	6,070	88,142	738,120	651,541	+ 13	6,835
Commerical buildings	5,491	77,248	12,631	20,456	29,262	36,161	181,249	1,447,560	1,343,699	+ 8	10,212
Unclassified, private	113	2,216	6,311	2,770	18,385	1,898	31,693	327,799	324,249	+ 1	6,110
Total private	8,693	98,161	30,070	37,749	85,829	44,129	304,631	2,519,511	2,320,313	+ 9	23,157
Total Engineering Construction											
Sept. 1948 5 weeks	41,297	161,615	98,073	76,541	185,536	102,355	665,417	.....	.....	.....	69,875
Aug. 1948 4 weeks	32,806	150,131*	66,862	92,313	145,939	76,141	563,792*	.....	.....	.....	55,514
Sept. 1947 4 weeks	25,842	118,726	67,223	63,714	163,221	56,079	494,805	.....	.....	.....	38,730
Nine months 1948	251,527	1,433,988	818,641	645,231	1,385,123	741,787	.....	5,276,297	.....	+ 28	377,204
Nine months 1947	160,013	1,052,995	704,820	559,976	970,928	657,670	.....	.....	4,106,402	.. ..	337,848
% Change '47 to '48	+57	+36	+16	+15	+43	+13	.....	.....	.....	.....	.....

*Revised

Alerts the Eyes and Ears ...for greater driving safety

New double-duty Traffic Marker guides drivers by sound and sight both day and night

A ribbon of white that clearly outlines the highway ahead . . . a surface that hums a warning to keep drivers in lane. That's the double-duty safety job performed, day and night, by this traffic lane separator.

Made with Atlas White Cement, this corrugated safety strip is constructed flush with the highway surface. By day, its whiteness, contrasting with pavement gray, visibly defines the lanes. By night, its saw-tooth faces catch headlight rays and reflect them back to the driver, forming a continuous ribbon of light.

In addition, in daytime or at night, the driver is immediately conscious of a distinct hum or whine should he veer out of lane and ride on the corrugated surface.

Thus the eyes and ears of the driver are constantly kept alert both day and night. Traffic is channelized . . . highway travel is safer.

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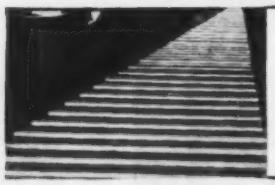

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ENGINEERING NEWS-RECORD

OCTOBER 14, 1948 VOL. 141 NO. 16

Little opposition develops to St. Lawrence power plan

At hearings before the Federal Power Commission one organization questions the commission's power to license a project, part of which is in Canada

Federal Power Commission hearings in Washington on the New York Power Authority's proposal to develop St. Lawrence power jointly with the Hydro-Electric Power Commission of Ontario opened Oct. 4 with a minimum of fireworks. By midweek the proceedings had settled into routine, though thorough, quizzing of the project sponsors by FPC's staff.

Authority questioned

The only serious effort to halt the hearings was made earlier by William F. Howe, attorney for the National St. Lawrence Project Conference. Howe questioned FPC's authority to license the development, and his group asked that the power authority's license application be dismissed.

The National St. Lawrence Project Conference, composed of interests that successfully fought various proposals before Congress for U. S.-Canadian construction of the St. Lawrence Seaway, is the only major organization openly opposing the New York plan. New York has asked FPC to license that portion of a proposed power plant across the International Rapids that will be located within the U. S. and will be operated by its power authority.

Howe contended that, since the St. Lawrence is an international boundary stream, any development therein would require the sanction of an international treaty or an agreement approved by Congress. He also held that, since a portion of the power facilities are to be located within Canada and operated by Ontario, FPC would be unable to license the entire project. Under the Federal Power Act, he argued, the commission has no authority to license a portion of a hydroelectric development.

FPC granted broad powers

FPC entertained the Power Authority application under terms of Section 4 (e) of the Power Act, which authorize the commission to issue licenses for projects in streams that affect "commerce with foreign nations."

Estimated costs

Gen. Francis B. Wilby (retired), chairman of the power authority, told the FPC that he had estimated the costs of construction of New York's portion of the facilities at $263,000,000, if funds can be obtained at 3 percent

Revised estimates made last year set the Thousand Islands section cost at $2,055,000. Cost of The International Rapids Section was divided thus: works solely for navigation, $66,079,000; works for power alone, $230,755,000; works common to both, $217,050,000 (*ENR* July 24, 1947, vol. p. 126).

Gen. Wilby said he had made no estimate of the portion of the power to be developed which might be available for use in other states than New York. Vermont, represented by a member of its Public Service Commission, previously had notified FPC that it hoped to obtain some of the project energy.

Name Franklin Thomas ASCE president for 1949

Franklin Thomas, dean of students at California Institute of Technology, was nominated as the American Society of Civil Engineers' president for 1949, on Oct. 12.

This action by the Board of Direction preceded the opening of the society's fall meeting on Oct. 13 at Boston.

Dean Thomas served as vice-president of the ASCE in 1944-45 and was a national director of the society from 1930 to 1933.

Appointed the chairman of the Colorado River Board of California last year by Gov. Warren, Dean Thomas has been a director of the Metropolitan Water District of California since 1928.

He joined the ASCE as a junior member in 1912 and advanced to the grade of member in 1923.

Navy opposes twin San Francisco span

Proponents of a "twin" to the existing Oakland-San Francisco bay bridge instead of the alternate southern crossing received a major setback last week.

Admiral D. B. Beary, commandant of the Twelfth Naval District and commander of the Western Sea Frontier, filed "strong opposition" from the standpoint of national defense to location of the new bridge alongside the present span.

"The parallel bridge proposed violates the fundamental strategic principle of dispersion," he declared in a letter to Col. S. N. Karrick, district engineer for the Corps of Engineers.

The state of California has applied to the Army for permits to construct two bridges, the high-level parallel span and a low-level combination causeway and tube between Alameda and Army Street. The Army has jurisdiction over structures built across navigable waters.

The state Department of Public Works originally favored the parallel bridge, which could be more economically built. The state Toll Bridge Authority subsequently approved both sites, expressing the hope that ultimately both could be erected.

Admiral Beary's letter called attention to one written to the Secretary of the Navy in July stating:

"It is believed that one modern missile landing at or near these parallel bridges would seriously damage or completely destroy these structures and deprive the city of San Francisco of direct lines of communication with the east bay area."

A report on the bridge sites from the state's division of San Francisco Bay toll crossings is expected to be presented to the Department of Public Works in the near future. Before the latter makes its formal recommendation to the Toll Bridge Authority, a public hearing will be held, Public Works Director Charles H. Purcell said.

NEWS BRIEFS

Labor—Medusa Portland Cement Co. gypsum and lime workers at the *Sandusky* and *Toledo, Ohio,* plants have struck for a 15-cent hourly increase. Company officials claim loss of one month's output for the state as a result of the stoppage. . . . Repaving of *Buffalo, N. Y.,* streets suffered a delay when city-employed operating engineers struck for a pay boost. . . . A jurisdictional dispute between carpenters and laborers in the *Minneapolis* area is due for joint board decision this month. . . . In *Boston* building trades hourly wages showed increases ranging from 5.3 to 25.3 cents in the year ending July 1.

Highways—*Ohio* is the latest state to report a highway study to be made by the Automobile Safety Foundation. The survey will cost $130,000 and take 18 months. . . . With ground broken on the Philadelphia extension of its Turnpike, *Pennsylvania* announces that 80 contracts will be awarded on the job during the next two years at a cost of $175,000,000. . . . *Texas* State Highway Department will let contracts totaling $6,586,500 on Oct. 26. . . . Bids will be opened at Albany on Oct. 27 for $3,356,000 worth of *New York* highway work. . . . N. A. Bader and Co., Inc., of Wilmington has been awarded the $1,053,096 contract for the Elsmere, Del., viaduct. To be completed in 1950 the viaduct will provide another entrance to the city of Wilmington.

Sewers and Water Supply—A $15,000,000 bond issue to rehabilitate three sewer districts in *St. Louis, Mo.,* has the approval of the Board of Alderman's committee on streets and sewers. . . . *Seaford, Del.,* announces that the first phase of its $963,000 sewerage system will be advertised for bids shortly. . . . *Morrisville, Pa.,* plans a $900,000 sewerage works. . . . Construction has started on the new $3,200,000 *Chester, Pa.,* water supply system. . . . *Miami, Fla.,* plans a new well field and water treatment plant to cost about $9,000,000. . . . Greely and Hanson, consultants of Chicago, are completing a plan for improving *Tampa, Fla.,* sewerage. This fall 40 percent of the project should be ready for bids.

Industrial Construction—Pacific Telephone & Telegraph Co. has started preliminary foundation work for a $3,500,000 six-story, steel-frame building in *Portland, Ore.* Robertson, Hay & Wallace is general contractor and Moffat, Nichol & Taylor, structural engineers. . . . Construction is due to begin on equipment maintenance facilities, costing $3,500,000, at the Monroe and Sherman open pit mines near *Chisholm, Minn.* . . . Kieffer Paper Mills, *Brownstown, Ind.,* plans to rebuild its $1,200,000 mill recently destroyed by fire. . . . Plans have been announced at *Indianapolis, Ind.,* for construction of a $2,000,000 metropolitan produce terminal at Brightwood Airport in 1949.

Public Construction—A 10-year building program for state colleges, costing $82,000,000 will be recommended to the *Wisconsin* legislature by the board of regents. . . . The University of Minnesota will build a 515-student dormitory under contracts totaling $2,625,000. . . . Haas and Rothschild, San Francisco general contractors were awarded a $2,278,000 contract on the new ward building and tuberculosis hospital at Sonoma State Home, *Eldridge, Calif.* . . . At *Knoxville, Tenn.,* a tuberculosis hospital will be built by Johnson and Willard of that city on a $2,785,000 bid.

Housing—Monroe Park Homes, Inc., Wilmington, Del., has let a contract of over $5,000,000 for a residential development near *Wilmington* to Anthony P. Miller, Inc., of Atlantic City, N. J. . . . A single bid of $1,825,715 for construction of Stage III of *Riverdale,* Garrison Dam town, was rejected by the Corps of Engineers. . . . Plans have been announced for a 502-unit rental dwelling project costing $5,000,000 at Kynlyn near *Bellefonte, Del.* . . . Maxwell Homes, Inc., is planning a $3,500,000 rental housing project at *Pasadena, Tex.*

Canada's army engineering put under chief engineer

The Corps of Royal Canadian Engineers will henceforth be administered by a chief engineer, it has been disclosed at Army headquarters. In the past the corps has been administered by the Director of Engineers, whose directorate is part of the General Staff branch of the army.

Col. H. L. Meuser, formerly director of engineers, is now ex-officio chief engineer under the new establishment.

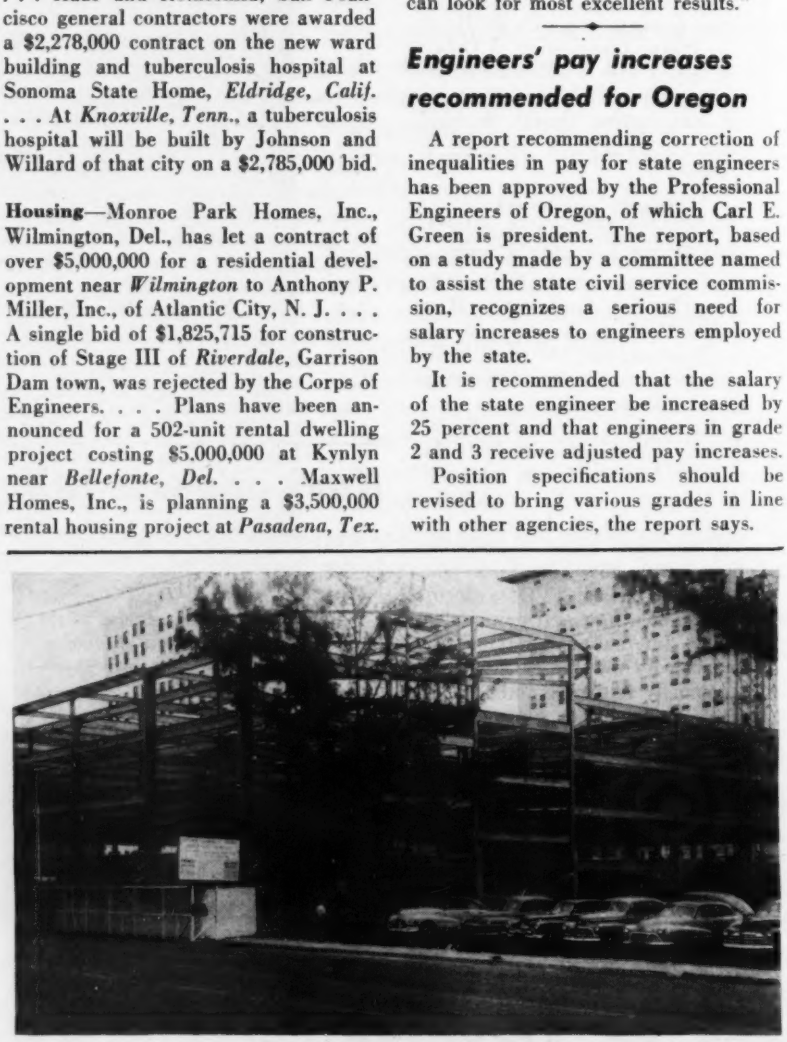
Brig. J. L. Melville, honorary colonel commandant, speaking of the creation of a chief engineer on the Canadian Army peacetime establishment said: "The divided control of the past was never satisfactory, and with control now unified in the chief engineer we can look for most excellent results."

Engineers' pay increases recommended for Oregon

A report recommending correction of inequalities in pay for state engineers has been approved by the Professional Engineers of Oregon, of which Carl E. Green is president. The report, based on a study made by a committee named to assist the state civil service commission, recognizes a serious need for salary increases to engineers employed by the state.

It is recommended that the salary of the state engineer be increased by 25 percent and that engineers in grade 2 and 3 receive adjusted pay increases.

Position specifications should be revised to bring various grades in line with other agencies, the report says.



ERECTED IN 22 DAYS this four-story steel frame of a Miami, Fla., garage totaled 990 tons in weight and was all-welded by the Lehigh Construction Co. The structure had its first load test in withstanding 100-m.p.h. gust velocities in the recent hurricane. It will cost $950,000 and accommodate 650 cars.

U. S. engineering-management firm named to supervise China aid program

J. G. White Corp. will act as technical adviser to joint U. S.-Chinese commission overseeing $70,000,000 recovery program

A joint U. S.-Chinese government committee, organized to aid the implementation of Marshall-Plan aid to China, last week announced the employment of a U. S. engineering firm to act as "technical staff" in the $70,000,000 aid program.

The J. G. White Engineering Corp., of New York City, will send out to China a small staff of six to ten engineers who will exercise supervision over other private engineering firms who are named as project engineers on various Chinese reconstruction work.

The appointment of the White firm represents in itself a major departure from procedure in administering the U. S.-sponsored aid elsewhere in the world. Instead of the more usual method under which each government sets up its own staff and then attempts to coordinate its work with the other, China and the U. S. mission have set up a non-voting consultative joint committee, which includes three Chinese and two Americans. With the aid of its technical adviser, this committee will operate as follows:

1. At the time that a provisional allotment is made for an announced project, the successful applicant for the work selects an engineering firm as its project engineer. The project engineer will in general handle most of the procurement of materials and equipment, as well as engineering work and installation supervision. The selection of a project engineer must be ratified by the joint committee.

2. The project engineer will draw up a bill of materials with detailed specifications, search world markets for cheapest and quickest deliveries, and present a fully justified project to the joint committee.

3. Upon approval of the project, the project engineer will arrange for procurement and delivery, and for construction and installation.

4. Financing will be done by European Cooperation Administration letter of commitment to a U. S. bank—in effect guaranteeing letters of credit to suppliers of materials for approved projects, and to the project engineer for his approved fee.

The White firm will supervise every step of this procedure, since the committee will take action only on approval of its "technical staff."

This entire procedure, of employing a project engineer to act for Chinese agencies, is new in ECA procedure, and is motivated by the desperate need for replacement and reconstruction equipment, and lack of foreign assistance in engineering and management. This situation required that engineering and management be furnished like any other commodity, along with equipment.

At the same time, ECA had other objectives—to promote the maximum use of private channels of trade, and to encourage resumption of trade with Japan and with the countries participating in the ERP.

The procedure is already undergoing a test, with four projects that were called a "trial run" by the ECA Chinese mission. These four projects, aggregating $4,400,000, have already been advertised and project engineers selected.

They are:

The Yangtze Power Co., of Nanking was allotted $1,200,000 and has employed the engineering firm of Anderson, Meyer and Co. to work up details of the replacement needs, procure materials, and install a new steam power plant; the Kailan Mining Administration, which has employed the Jardine Engineering Co. on a $1,000,000 project; the National Resources Commission, which has employed William Hunt and Co. on a $1,200,000 job on its Tientsin-Pieping power system; and the Taiwan Sugar Co., which has employed the General American Transportation Co. on a $1,000,000 project.

All four of the project engineers maintain engineering staffs in China, and all have records of long business association with their applicant clients.

Urges AISC to avoid non-essential building

In his opening remarks before the annual American Institute of Steel Construction convention at Quebec last week, T. R. Mullen, president of the organization, urged that non-essential construction be avoided in these days of high costs. Calling steel too basic a commodity to be wasted, he said self-restraint must be demonstrated if an "inefficient system of direct government control is to be avoided."

His talk was concerned principally with reporting the 1948 activities of the institute, the membership of which represents 85 percent of the country's steel fabrication tonnage.

At the closing session of the meeting, the AISC elected N. R. Patterson as its president. As president of Patterson Steel Co. of Tulsa, Okla., he has been a prominent figure in the southwest construction industry for the past 25 years.

Mr. Patterson succeeds Mr. Mullen who presided over the four-day convention attended by over 500 construction men.

Other institute officers elected include: R. D. Wood, Chicago, first vice-president; J. Phillip Murray, San Francisco, second vice-president; John E. Jackson, Pittsburgh, treasurer. L. Abbett Post, executive vice-president and M. Harvey Smedley, secretary, both of New York, were reelected. B. E. Bushnell, Jacksonville, Fla., was elected to the board of directors.

Start work on Folsom Dam, $180 million Calif. job

A dynamite blast broke ground recently for construction of Folsom Dam, multi-purpose project which will store 1,000,000 acre-ft. on the American River in northern California.

Principal speaker at the ground breaking ceremonies was Gen. P. A. Feringa, chief of the Corps of Engineers civil works division at Washington. Charles H. Purcell, California director of public works, represented Gov. Earl Warren.

Richard L. Boke, regional director of the Bureau of Reclamation, spoke for that agency, which will develop the water and power distribution systems in the project.

Cost of the completed project, including the dam, the power plant and an afterbay dam and power plant below the main dam, has been estimated at $180,000,000.

The rolled earthfill main dam and auxiliary dikes will have a maximum height of 280 ft. and will be 23,300 ft. long. The spillway will be of reinforced concrete controlled by radial steel gates. Irrigation and power releases will be made through a 24-ft. concrete-lined tunnel.

Appraisers to discuss construction costs

One entire session of the National Appraisal Conference to be held in New York on Nov. 12 and 13 will be devoted to construction costs.

The conference is to be held by the American Institute of Real Estate Appraisers at the Engineering Societies Building.

Essay contest to stimulate interest in highway engineering work

American Association of State Highway Officials sponsors plan to get engineering students to consider road building as a career

To stimulate interest in highway engineering careers among civil engineer students, the American Association of State Highway Officials has launched a National essay contest. The contest is in two divisions, one for third-year civil engineering students and the other for faculty members.

The winner in each division will receive an all-expense paid trip to the 35th annual meeting of the AASHO in San Antonio, Tex., Oct, 1949. At that meeting the two authors will present their winning papers before a general session of the association.

Junior year civil engineering students will write on "What I think of highway engineering as a career"; and faculty members' papers will be on the subject, "What I advise my students with regard to selecting highway engineering as a career."

Contest rules were sent out with an accompanying letter Oct. 1 from AASHO Washington headquarters to 132 engineering schools. The closing date for submitting papers is March 1, 1949, but by Nov. 1, 1948, each school must signify its intention to participate.

Needed promotion scheme

Decision to hold the contest was made by the AASHO executive committee during the recent annual meeting in Salt Lake City (*ENR* Sept. 30, p. 39). Need for active work in promoting highway engineering as a career for civil engineer graduates was emphasized earlier this year by an AASHO Survey (*ENR* April 1, vol. p. 475). That study showed that only one-sixth of the civil engineering students due to graduate last June indicated any interest in taking jobs with state highway departments or the Public Roads Administration. The AASHO is tackling some features of the problem by working for adequate salaries and sound personnel policies in all its affiliated highway organizations.

Because highway engineering has been allowed to lose some of its glamor as a career, other means are needed to revive interest among students and teachers, in the opinion of AASHO officers. That is the underlying reason for the present contest.

Entries of students and faculty members will be submitted to the chief administrative officers of the highway department in the state or territory in which the college or university is located. A board of judges appointed by the chief officer from the personnel of his department will select the student and faculty winner from that state. The two winning papers then will go to a national board of three judges in Washington for determination of the national winners. Names of the two winners will be announced the first week of June, 1949.

Engineers participate in safety conference

Construction men, engineers, executives and safety directors played a leading part in the organizational meeting of the President's Conference on Industrial Safety in Washington recently. Vincent P. Ahearn, executive secretary of The National Sand & Gravel Association, headed the meeting as executive director.

The meeting established the scope, objectives, committee organization and procedure for the seven technical committees of the conference. The committees presented preliminary reports and recommendations for consideration by the conference members at a comprehensive meeting scheduled for early spring.

The engineering committee broke down its studies and analyses into six divisions, each tackled by a separate subcommittee. First of these is a group to study a program on safe design and layout of plant structures and processes.

Other subcommittees of the engineering committee laid out programs for: A study of the relationship between safety and efficiency, establishing techniques to the prevention of accidents, analyzing problems in the design and safeguarding of machinery, tools and equipment, studying means of integrating safety into industrial organizations, and appraising the adequacy of safety engineering standards and of procedures for writing such standards and applying them.

STONE STARTS ROLLING at the Clark Hill Dam aggregate plant on the Savannah River near Augusta, Ga. Shown here en route from primary to secondary crusher, the stone will feed a 200 cu. yd. per hour concrete plant operated by Allstate Constructors, Inc.

Compton of M.I.T. resigns to take government post

Karl Taylor Compton, for the last 18 years president of Massachusetts Institute of Technology, and one of the leaders in the field of engineering education, has announced his resignation to take effect Oct. 15. Dr. Compton will succeed Vannevar Bush as chairman of the Research and Development Board of the National Military Establishment. He will be succeeded at M.I.T. by James Rhyne Killian Jr., vice-president since 1945.

Dr. Killian will be the first M.I.T. graduate to take office as president of the institute. He was born at Blacksburg, S. C., in 1904, attended Duke University and M.I.T., having graduated from the latter in 1926. He received honory degrees from Middlebury College and from Union College.

CAA Alaskan appointment for Lample made official

Chris M. Lample, veteran airways official of the Civil Aeronautics Administration, has been appointed Administrator of Alaska Airports, D. W. Rentzel, Administrator of Civil Aeronautics, announced last week (*ENR* Aug. 26, p. 3).

Mr. Lample left for Alaska Sept. 27, culminating 16 years of vigorous personal boosting of Alaska in aviation matters. His principal aim is to expedite construction of two big new airports at Anchorage and Fairbanks (*ENR* July 29, p. 2, Aug. 12, p. 2 and Aug. 19, p. 76) and to establish them on a firm business basis so that some day they can be returned to the local communities for future operation.

Using $12,500,000 appropriated this year, the CAA is constructing a Class 5 airport at Anchorage and a Class 4 airport at Fairbanks, each large enough for use by international air lines and by the military.

6 months permits total $3.5 billion

City building construction in the first half of 1948, as measured by building permits issued and federal contracts awarded, was valued at $3.5 billion, an increase of 54 percent over valuations for the first half of 1947, according to preliminary estimates of the Bureau of Labor Statistics, U. S. Department of Labor. All types of building and all regions of the country shared in the rise this year.

April marked the peak in valuation of urban building construction authorized during the first 6 months of 1948, when the dollar volume hit $715 million, only 4 percent under the all-time high recorded in March, 1946. Two-thirds of the April figure represented permit valuations of new residential building, which almost doubled between February and April—just prior to the expiration on April 30 of Title VI (with its liberal financing terms) of the National Housing Act. In May, the total dollar volume of city building declined to $657 million, but rose in June to $686 million.

New home construction accounted for over half of the dollar volume of all urban building construction authorized in the first 6 months of this year. Residential permit valuations totaled almost $1.9 billion and were 56 percent above the amount authorized in the corresponding months of 1947.

Nonresidential building, which had been restricted by federal controls during the first half of 1947, was higher by 65 percent this year with a total valuation of $1.1 billion. While industrial contruction was only slightly above the 1947 level for the first 6 months, important gains were scored in all other types of long-deferred nonresidential building. Commercial construction rose 81 percent over the first half of 1947 to reach a dollar volume of $453 million. Community buildings (including hospitals and schools) increased 124 percent to $356 million, and the $36 million valuation of public buildings (federal, state, county and municipal) was higher for the first 6 months of 1948 by 84 percent.

Cities in the Pacific region led all others for the first 6 months of 1948, with total permit valuations of $754 million, followed by those in the east north central region ($697 million). However, cities in the Middle Atlantic region showed the greatest proportionate increase over last year for the first 6 months—78 percent to $597 million.

MAJOR MEETINGS

American Public Works Association, public works congress and equipment show, Copley Plaza Hotel, Boston, Oct. 17-20.

Federation of Sewage Works Associations, with annual meeting **Michigan Sewage Works Association,** Hotel Statler, Detroit, Mich., Oct. 18-21.

National Safety Congress, Stevens Hotel, Chicago, Ill., Oct. 18-22.

Joint Meeting Four States and Western Pa., sections of A.W.W.A., Penn Sheraton Hotel, Philadelphia, Pa., Oct. 20.

National Conference on Industrial Hydraulics, Sheraton Hotel, Chicago, Ill., Oct. 20-21.

New England Highway Exposition, Commonwealth Armory, Boston, Mass., Oct. 20-22.

Structural Engineers' Assn. of California, annual convention, Biltmore Hotel, Santa Barbara, Calif., Oct. 21-24.

American Welding Society, annual meeting, Bellevue-Stratford Hotel, Philadelphia, Pa. Week of Oct. 24.

American Public Health Association, Boston, Mass., Nov. 8-12.

National Reclamation Association, Oklahoma City, Okla., Nov. 17-19.

Another building month, another building record

New construction put in place in September, valued at $1,804,000,000, set another new monthly record, according to the joint estimate of the Commerce and Labor Departments.

The record September figure represents a rise of 1 percent over August and of 27 percent above the figure for September 1947. It was made in a month usually marked by a small seasonal decline in construction, John L. Haynes, chief of the Construction Division, Department of Commerce, pointed out.

The estimate for September brings the value of new construction put in place during the first nine months of this year to $13,000,000,000, 34 percent above the total for the comparable period of 1947.

See progress at Portland on 155 mgd. sewage plant

In spite of delays caused by a shortage of materials, good progress has been made during the first year of construction on the $14,000,000 sewage disposal project, at Portland, Ore. (*ENR* Jan. 24, 1946, vol. p. 139).

The system, designed to handle sewage for a population based on 1980 estimates, will have a capacity three times the average sewage disposal of present facilities.

Primary purpose of the project is to eliminate dumping of sewage into the Willamette river and Columbia slough. It is in line with a valley-wide program to remove pollution from the Willamette and may be completed in 1951.

Contracts for the project are being awarded in sections. Total amount of contracts so far awarded is $1,702,959. Largest of these is the Columbia boulevard section, which is under contract to the Guy F. Atkinson company for $671,600. This section involves construction of a 102-in. semi-elliptical monolithic concrete sewer that will feed 155 mgd. directly into the plant.

Pipeline and blast furnace announced by H. J. Kaiser

The construction of a new $189,000,000 pipeline and a $17,000,000 blast furnace were announced last week in Los Angeles by Henry J. Kaiser. The 1,840-mi. pipeline is a project of the Transcontinental Gas Pipe Line Co. of Texas and will carry Texas natural gas to New York City. The blast furnace will be constructed at Kaiser's Fontana steel mill. Its capacity of 1,200 tons per day of pig iron will be equal to that of the present installation.

The connection between the two projects is that Transcontinental will advance money for construction of the furnace, taking payment in steel plate. About $60,000,000 and 500,000 tons of steel are involved and at the completion of the contract Kaiser will hold title to the new Fontana expansion.

The engineering on the furnace is being handled by Kaiser Engineers under the direction of Chief Engineer George Havas. The same group will act as general contractor when construction starts about Dec. 1.

The original blast furnace at Fontana, built in 1942, was completed in less than a year through establishment of a 24-hour, 7-day-week schedule. According to Kaiser's recent statements to RFC in appealing for debt reduction on the mill, this ran up costs. In spite of higher costs Kaiser expects to set a similar schedule for the expansion.

The contract between Kaiser and Transcontinental calls for delivery of plates to start Jan. 1, 1949, and is to run for two years. This means an average of about 20,000 tons per month and will represent a considerable portion of Fontana's plate rolling capacity. Thus orders to Kaiser's present industrial, structural and other customers will have to be curtailed for a while.

$800 million Washington road need

Highways of the state of Washington have deteriorated to the point where $868,611,000 in construction work will be required in the next ten years, according to an engineering report presented late last month to a joint fact finding committee of the state legislature (*ENR* Oct. 7, p. 6).

G. Donald Kennedy, consultant in charge of a year-long investigation of state highway, county road and city street systems, summarized the report for the committee at a public meeting. Mr. Kennedy is vice-president of the Automotive Safety Foundation, Washington, D. C.

In presenting the construction cost estimates, he reported that 48 percent of the total, or $417,286,000, was needed to correct conditions so critical that they require immediate attention. He gave the total needs by systems as: state highways, including urban connections, $575,323,000; county roads, $176,735,000; city streets, $116,553,000.

The survey, authorized by the 1947 legislature, revealed that 52 percent of the total mileage in the state is unfit to render safe, convenient and economical service. Stated another way, 27,378 of the 52,456 miles require improvement, along with nearly 3,000 bridges.

Percentage of deficient mileage on the various systems was found to be: primary state highways, 86 percent; secondary state highways, 90 percent; urban state highways, 40 percent; primary county roads, 78 percent; other county roads, 42 percent; arterial streets, 59 percent; other city streets, 22 percent.

The need for improvement, Mr. Kennedy pointed out, was greatest on the principal roads and streets carrying the heaviest volumes of traffic.

Three programs presented

For the convenience of the committee and the legislature, he explained, the long range program of highway improvement was prepared in alternative ten, 15 and 20 year periods. Average annual costs were worked out to include expenditures for construction, maintenance and administration.

A ten-year program would require average annual outlays of $96,778,000; a 15-year program would cost $76,360,000 a year, and over a 20-year period the yearly expenditures would average $67,128,000.

Before the engineering staff developed the long-range improvement programs, many aspects of highway and street problems were studied, Mr. Kennedy said. A study of the growth of the state's population and the concurrent increase in traffic volumes indicated that highway facilities will be required for 2,621,000 people in 1960, and 2,826,000 in 1970. As the population grows and the state's economy expands, travel will become heavier year by year. Vehicles were driven more than 7,000,000,000 miles in Washington in 1947. At the predicted rate of increase, the total will be nearly 9,500,000,000 miles in 1960 and will exceed 10,000,000,000 miles by 1965.

One of the conclusions of the study was that classifications of primary county roads and arterial city streets should be established to facilitate administration and the programming of improvements on the basis of greatest need.

The report urged that the routes of all state highways through cities be made the responsibility of the State Department of Highways, with proper authority to cooperate with local governments in construction, maintenance and operation.

It was recommended that 172 miles of highways in the Columbia Basin be added to the state highway system to meet the needs of that rapidly expanding area.

Particular emphasis was placed on the application of adequate standards of design for roads and bridges to insure that facilities would safely and conveniently handle the traffic loads of the present and the future.

ASF personnel direct study

Mr. Kennedy organized and directed the project, and Joe O. Mattson, assistant to the Foundation's president, served as a consultant. The supervising engineer was Carl E. Fritts of the Foundation staff, who also supervised the recent study for the neighboring state of Oregon (*ENR* Sept. 16, p. 73). C. F. McCormack of Seattle was resident engineer.

At the request of the fact-finding committee, the state department of highways, the Washington State Association of County Commissioners and the Association of Washington Cities organized engineering committees to work directly with the staff.

Much of the material in the printed report is presented graphically in the form of maps, charts, photographs and tables to highlight the engineering details in a manner easy for the layman to grasp. The graphic presentation, layout and printing were supervised by Robert L. Steinle, and the text was written by Raymond F. Law, both connected with Executive Research, Inc., Los Angeles, Calif.

Deep wells to be drilled to augment Arizona water

Contracts to drill ten wells for the Salt River Valley Water Users Association in central Arizona have been approved, following subscription of more than $1,000,000 from association shareholders.

The wells will be the first of a series of 20- to 24-in. bores to be sunk to the 700-ft. level in an effort to augment the valley's dwindling supply of reservoir water.

Groundwater basin studies to determine critical areas under the new Arizona groundwater code will be completed in Pinal County by Dec. 1, according to O. C. Williams, state land and water commissioner.

The Pinal County survey is the result of applications by soil conservation districts.

Water levels in Pinal wells are 22.2 ft. below their average level of five years ago.

Drought effects are indicated in other southern areas of the state where wells are anywhere from 5 to 11 ft. below the averages of two years ago.

Under the state groundwater code, critical areas will be rigidly controlled. Pumping will be restricted and the sinking of new wells or opening of previously unirrigated land prohibited.

This code was passed at a special session of the state legislature last spring. It will satisfy one of the conditions set by the Bureau of Reclamation for construction of the multi-million dollar Central Arizona Project.

Utah and Wyoming fail to agree on water

A recent meeting of Wyoming and Utah water officials at Rock Springs, Wyo., was short but not especially sweet.

The meeting ended abruptly after 10 minutes because of divergent points of view on rights to water draining from the north flank of the Uinta Mountains. Representatives of each of the states had driven more than 200 miles apiece for the session.

The conference closed when Utah's delegation demanded that its state receive surplus water draining from the north flank of the Uintas subject to existing rights. Wyoming refused the demand because its representatives claimed that under an agreement reached previously at Vernal, Utah, 14 percent of the water of the upper Colorado River basin is automatically alloted to Wyoming (*ENR* Aug. 8, p. 57).

OBITUARY

William Roth Work, 67, assistant director of the College of Engineering and Science, Carnegie Institute of Technology, and one of the institution's first faculty members, died in Pittsburgh, Pa., Oct. 3. He had been affiliated with Carnegie since 1905. He took a master of engineering degree at Ohio State College in 1905. During the first world war he was a member of the Committee on Education and special Training of the War Department General Staff.

Egmont Smith, 56, former chairman of the Southwestern section of the American Water Works Association exhibit committee, died at Dallas, Tex., Oct. 3. He had been branch manager of the Dallas office of the Neptune Meter Co. since 1929 and had been with that company since 1910.

Ernest F. Hodgson, 77, pioneer developer of prefabricated houses, and organizer of the E. F. Hodgson Co., Inc. of Dover, Mass., died on Oct. 3 at his home in Boston. He formerly manufactured portable garages and then turned to construction of prefabricated houses by mass production methods.

Lyons Mussina, 64, city engineer of Williamsport, Pa., for the last 28 years, died there on Sept 22. He had worked as a construction engineer on the Panama Canal.

Raymond E. L. Krumm, 75, retired Columbus, Ohio, civil engineer, who died recently while visiting in Kane, Pa., left his entire estate for the education of Korean students at Ohio State University and the rehabilitation of a public well in Schiller Park. Krumm was at one time chief engineer for the Korean government.

Harold A. Axtell, 58, senior architectural engineer with the Public Buildings Administration, died Oct. 5 at Washington, D. C. He was graduated from Cornell University, receiving a degree in civil engineering in 1911. Before joining the government service in 1933, he was engaged in private construction.

Harry F. Johnson, 78, of Detroit, Mich., died there Oct. 3. During 1930 to 1932, he was in charge of the only complete sounding of the Great Lakes for the U. S. Lake Survey office at Detroit, whose staff he had joined in 1892 after having been graduated from the University of Michigan.

Henry Bloompot, 72, chief of the special studies and reports branch of the engineering division of the U. S. Engineers depot at West Memphis, Ark. and employed there since 1927, died Oct. 5. He had made studies of various river and flood control projects.

L. W. Richardson, 44, who had been an engineer for the H. K. Ferguson Construction Co., died in Decatur, Ill., Sept. 25. For 28 years he was an engineer for the City Light & Tractor Co. of Sedalia, Mo.

Nat L. Marks, Jr., 50, for 18 years city engineer of New Orleans, La., died Sept. 30. He was a civil engineering graduate of Tulane University, 1924.

Clark Dillenbeck, 82, former chief engineer of the Reading R. R. Co., died at Plainfield, N. J., Oct. 9. He had retired ten years ago after nearly 50 years with that railroad. He was graduated from Cornell University in 1888 and the next year he joined the John G. Ferris Steel Co. in Pittsburgh, Pa. In 1890 he became an engineer and architect for the Reading and took the post of chief engineer in 1927.

Archie L. Wann, 53, field engineer in charge of construction and maintenance for all properties of the Indiana Gas and Water Co., died Oct. 2 in Noblesville, Ind.

Andrew K. Selden, 94, construction engineer, who served as assistant Washington, D. C., building inspector for nearly 25 years, died Oct. 1 in Charles Town, W. Va. Previously he was a construction engineer in Knoxville, Tenn.

Louis Cohen, 72, died Oct. 1 in Washington, D. C. He had served on the scientific staff of the Bureau of Standards for four years. In 1921, he joined the War Department as a consulting engineer.

Richard J. Durley, 70, secretary of the Engineering Institute of Canada from 1925 until his retirement in 1938, died in Montreal recently. He was a graduate of University College London, England.

CONSTRUCTION ACTIVITY

CONTRACT VOLUME

Continental U. S. Only
(Millions of Dollars)

	Week of Oct. 14 1948	Cumulative 1948 (42 wks.)	Cumulative 1947 (42 wks.)	% Chge
Federal	$23.6	$789	$514	+54
State & Mun.	58.6	2,119	1,391	+52
Total Public	$82.2	$2,908	$1,905	+53
Total Private	88.0	2,709	2,553	+ 6
U. S. Total	**$170.2**	**$5,617**	**$4,458**	**+26**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Millions)

Type of Work	This Week	Cumulative 1948 (42 wks.)	Cumulative 1947 (42 wks.)	% Chge
Waterworks.	$2.6	$167	$89	+88
Sewerage ..	5.6	178	111	+60
Bridges	2.1	230	150	+53
Highways...	11.2	839	644	+30
Earthwork, Waterways.	17.7	425	243	+75
Buildings, Public	41.7	891	463	+92
Industrial .	57.8	858	723	+19
Commercial	22.0	1,502	1,487	+ 1
Unclassified.	9.7	527	548	— 4

NOTE: Minimum size projects included are: Waterworks and waterway projects, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (42 wks.)	Cumulative 1947 (42 wks.)	% Chge
NON-FEDERAL ..	$3,720	$1,935	+ 92
Corporate Securities	1,745	720	+142
State and Municipal	1,483	967	+ 53
U. N. Building Loan	65	....	....
Fed. Aid Highway	427	248	+ 72
FEDERAL	1,559	819	+ 90
Total Capital	**$5,279**	**$2,754**	**+ 92**

As Reported this week to ...
Engineering News-Record

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Oct.'48	480.21	230.84
Building Cost	Oct.'48	357.07	193.02
Volume	Sept.'48	240	105

EDITORIALS

VOLUME 141 NUMBER 16

October 14, 1948

Accent on Municipal Public Works

MEETINGS of the American Public Works Association at Boston and the Federation of Sewage Works Association at Detroit next week afford two excellent opportunities for municipal administrators and sanitary engineers to exchange ideas for improving public-works practices. Numerous timely questions call for discussion: What technical developments can be applied to cut construction and operation costs? Can material shortages be solved by substitution or improved design? How can new-project expenditures be reduced by more careful engineering? Some of the answers may be found in this issue as, for example, in the application of a simple yardstick for estimating the cost of a proposed sewage plant, or in a comparison of design factors, costs and procedures used in taking bids for two major incinerator installations. If the problem is snow removal, the report on how organization, timing and teamwork kept streets clear in Lansing Mich. is full of suggestions. Equally useful are design articles relating to sanitary sewers and bus garages. Taken together, these articles indicate that municipal public-works practice is benefiting from new engineering and managerial techniques. They also suggest that broadest participation in the development and application of such techniques is needed if answers to the pressing questions of the day are to be found.

Sell Road Needs Locally

FAILURE OF THE STATES to use all of the highway funds assigned to them by the federal government has delayed construction of vitally needed road improvements. The situation can become worse unless measures are quickly taken to correct it. What these measures should be must be determined by each state. If the problem is lack of engineers, immediate help can be obtained by farming out part of the engineering to private firms, where that can be done legally, while building up public support for more adequate pay for highway engineers. If state funds are inadequate for both maintenance and matching federal aid, then active support should be sought for legislative action on road-tax diversions in states where diversion still is practiced. Bond issues can also be used if it is clear that adequate highways cannot be provided with current revenues. In case the lack of cement has slowed construction, a suggestion of the cement manufacturers is worth consideration. This is to purchase cement for delivery in the early spring when manufacturers' storage silos are full, causing them to slow production or to sell their output in export markets. Illinois followed this practice with success a number of years ago, allowing contractors 10c a barrel extra if they would store a part of their requirements prior to the start of the construction season. Regardless of what specific action is indicated by local conditions, however, the important requirement is for more ingenuity and vigor in attacking the problem of highway expansion. A basic requirement in most cases is to sell the public and the legislators on the inherent costliness of inadequate and deteriorating highway. That will not be easy, but just waiting for some simple solution to turn up automatically is dangerous in the extreme.

Opportunity and Responsibility Abroad

OUR COUNTRY'S POSITION of world leadership brings no segment of our population more opportunity or responsibility than it does our engineers and construction men who constitute the vanguard of every foreign venture that we elect or are forced to carry out. A prime example of this fact is afforded by the Arabian American Oil Co., which is currently commemorating the fifteenth anniversary of its petroleum exploration and development project in Saudi Arabia. There, in the years since 1933, an investment of $150 million of American capital has transformed a desert waste, as harbors, roads and towns were built, pipelines laid, wells drilled and refineries constructed. Most significantly, several thousand nomadic Bedouins have been taught to become skilled craftsmen and competent workers, to improve their level of health and to raise their standards of living. Large payments made to the government of Saudi Arabia have also been used to extend these advantages to more of the country's people. This is not imperialism, for instead of "extending the control, dominion or empire" of the United States, it merely establishes a business relationship on the basis of mutual advantage. What has been done so far in Arabia by American capital and American engineers and construction men deserves emulation. Our responsibilities abroad can best be

discharged by extending the fruits of our private enterprise system in the dual role of development and education. Therein, too, rest our greatest opportunities.

Professional Fee Schedules

A RESTUDY OF SCHEDULES of fees for professional engineering services and of regulations relating to those schedules is badly needed. Current schedules are not in harmony as to amounts to be charged for similar types of work, and appear to lack any close relation to actual engineering costs. Further, since some state societies of professional engineers propose to use their schedules as the basis for disciplinary action, any restudy should include thoughtful analysis of the legal questions raised by such proposals.

Fee schedules for architectural and engineering work in this country have been in use for 40 years. Originally, they were few in number and their chief function was to inform prospective clients of the *minimum* rates for engineering services.

Those schedules lacked uniformity in the amounts specified for work of varying magnitude; and it seems probable that the so-called "minimums" were educated guesses as to what the engineering costs would be on the simplest type of operation in each cost bracket, allowing a fair profit for the engineer. The lack of uniformity was of no significance then, as few clients ever saw more than one schedule.

In recent years, however, most state societies of professional engineers have adopted fee schedules. As a result, consultants who practice in several states and have been in the habit of basing their fees on the ASCE schedule, or on the schedule of their home state, are finding that proposals made to prospective clients elsewhere are out of line with what the local state society says they should be. The resulting embarrassment and confusion points clearly to the need for much more uniformity.

It should not be too difficult to get more uniformity in the schedules in general use, provided some national agency such as the National Society of Professional Engineers or the Engineers Joint Council would undertake to make a realistic determination of what the average figures should be. This will require cooperation from individual practitioners, because such a study should be based on actual fees paid, not on educated guesses. Analysis of the figures by regions also should be undertaken to determine where regional adjustment should be made in the schedule.

It will be difficult, however, to get wide acceptance of national or regional schedules while some of the state societies hold to the belief that failure to conform to a schedule of minimum fees should be a cause for disciplinary action. This has been proposed to implement a belief that standards of practice and compensation for engineering employees can be improved by requiring consultants not to charge less than specified minimum rates. For example, the schedule of fees of the Pennsylvania Society of Professional Engineers says: "Noncompliance with the terms of this schedule will be considered unethical practice." When it is realized that most state societies and state licensing boards hold that unethical practice is a cause for revocation of license, the seriousness of such a provision begins to become apparent.

Also, it seems probable that such a plan is impracticable, because no superior court would uphold a license board's revocation of a license for such a cause. So long as an engineer renders adequately the service called for under his contract, there is nothing illegal in his charging a fee below the minimum to get business or to keep his organization together—as many engineers did during the depression—and no competent court would make a finding to the contrary. Such a provision in a schedule or code is an empty gesture.

Not to be overlooked is the possibility that attempts to make use of a specified minimum fee mandatory might be held to be a violation of the anti-trust law.

All of which leads to the conclusion that plans to use fee schedules for purposes other than as guides to clients should be dropped, and attention centered on getting the greatest possible amount of uniformity into state and national schedules at an early date.

These schedules should contain average rather than minimum figures as averages will permit greater flexibility without appearing to depart too radically from the schedule. Also, average figures will automatically eliminate the possibility of anti-trust action.

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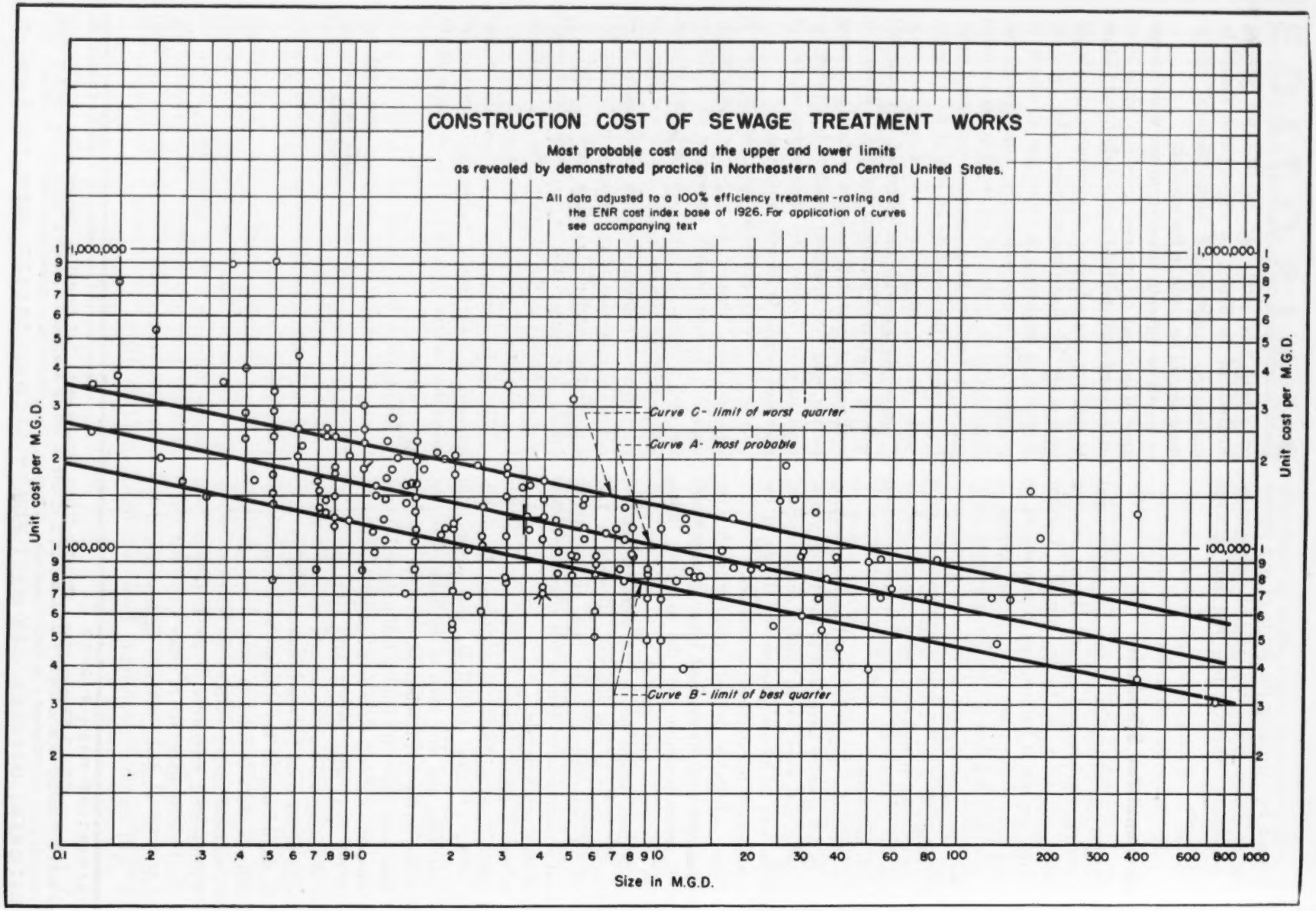

CONSTRUCTION COST OF SEWAGE TREATMENT WORKS
Most probable cost and the upper and lower limits
as revealed by demonstrated practice in Northeastern and Central United States.
All data adjusted to a 100% efficiency treatment-rating and the ENR cost index base of 1926. For application of curves see accompanying text
Curve C - limit of worst quarter
Curve A - most probable
Curve B - limit of best quarter
1,000,000
100,000
Unit cost per M.G.D.
Size in M.G.D.
0.1
.2
.3
.4
.5
6
7
.8
9
10
2
3
4
5
6
7
8
9
10
20
30
40
60
80
100
200
300
400
600
800
1000

How Much Should Sewage Treatment Cost?

Here is a yardstick based on demonstrated practice that provides a means for measuring the construction cost of proposed disposal plants.

C. J. Velz
Head, Civil Engineering Department, Manhattan College, New York City

***EDITOR'S NOTE:** Many efforts have been made to assemble data that would accurately portray the construction-cost range of sewage-treatment works. It is believed that the following statistical analysis by Professor Velz provides the most useful yardstick yet devised for such a purpose.*

From a study of the costs of actual plants, reduced to a common base for comparison, Professor Velz has developed three curves, representing what he calls the most probable, the best and the worst quarter of practice. Knowing the size of a proposed plant in terms of capacity, the required efficiency of treatment and prevailing value of the ENR Construction Cost Index number, it is a simple matter to obtain from these curves a reliable estimate of the plant costs.

Use of these curves is not intended to supplant the need for a detailed engineer's estimate. But they should prove of great usefulness for evaluating relative costs of projects prior to their actual design, and particularly as a means for checking cost estimates of a specific project against demonstrated practice. Comments on the use of these curves will be welcomed for publication.

WITH THE OBJECTIVE of obtaining a yardstick by which the cost of sewage-treatment works may be measured, *Engineering News-Record* in cooperation with Manhattan College School of Engineering instituted a comprehensive analysis of the past record of costs in the United States. The study was limited to the cost of construction of the treatment works, exclusive of sewerage systems, booster stations, interceptors and outfalls. Either bid prices or final payments to contractors were used, excluding preliminary expenses, land, engineering, legal, and interest charges during construction.

Two sources of data were utilized, the technical journals and an *Engineering News-Record* questionnaire. An exhaustive search was made of published articles from 1920 to date for reported costs and detailed descriptions of works. In addition, a questionnaire was sent to superintendents of 2,500 plants, excluding military installations. Data were collected for about 500 plants, and this is the first article to result from the screening of the information.

Other phases of the cost study will be published as further data permit extensions. It is readily agreed that no single measure of cost can reflect economy, extravagance or extraordinary design requirements. Accordingly, several bases of evaluation are contemplated. From the standpoint of design capacity, cost may be rated on a hydraulic basis in terms of million gallons per day (Mgd), and on a biochemical-oxygen-demand (BOD) basis in terms of population equivalents. On the other hand, a study of the cost-per-capita on a population basis related to the year the works are constructed will reflect the degree of over-capitalization of facilities.

Basis of analysis

In the present analysis, all plant costs are referred to 1926 as the base year of construction, adjusted by means of the *ENR* Construction Cost Index. They also are referred to a 100 percent efficiency base by considering primary, chemical coagulation, trickling filter and activated sludge systems as effecting 35, 65, 85 and 90 percent BOD removal, respectively.

As further data become available, separate groupings as to types, unadjusted for efficiency, are also contemplated. Recognizing regional price differentials, works also will be segregated into geographical regions for separate study.

With the data available, treatment works considered in this article are confined to those located in the consolidated regions north and east of the Ohio and Missouri Rivers, including Maryland. In Tables I and II are shown the distribution of works by states and by types of treatment systems.

The information was screened for reliability of reported costs, but no attempt was made to minimize variations by deleting high or low extremes. Following such screening, the data were handled statistically and various tests indicate a normal representative sample.

The relation between unit cost per million gallons per day of design capacity and size of works in million gallons per day is shown in Fig. I. The degree of the logarithmic relationship between unit cost and size is of a reasonably high order, with a coefficient of correlation of minus 0.61 plus or minus 0.03. It will be noted there is negative correlation and hence as the size of the works increases the unit cost decreases, but since the relation is logarithmic, the proportionate saving diminishes with increasing size.

The line of "best fit" through the data, Curve A, represents the average practice or the most probable unit cost. In addition, lines of scatter

enclosing the central 50 percent of the data were established. Curve B represents the boundary of the best quarter of the practice, while Curve C is the boundary of the worst quarter.

Whether a particular treatment works falls within the middle half or above or below the upper- and lower-quarter lines depends, in addition to extravagance or economy, upon local factors such as unusual foundations, rock excavation or high groundwater conditions. Also, in some instances higher first costs may have been justified by lower operating costs. These factors should be considered in evaluating any specific project.

How to use the curves

The following example illustrates the use of the curves. Assume a treatment works for a community of 80,000 population requiring 8 mgd. capacity and capable of producing an 85 percent reduction in BOD (in other words, a trickling-filter system) is to be bid during the autumn of 1948.

From Curves A, B and C the unit-cost range within which 50 percent of the treatment works of 8 mgd. capacity could be expected to fall is $78,000 to $145,000 per mgd., with the most probable at $106,000, referred to 100 percent efficiency and the 1926 cost base.

Assuming the *Engineering News-Record* cost-index value at time of bidding to be 230, and reducing to 85 percent efficiency, the most probable cost of construction of this plant would be $1,658,000 (106,000 x 2.30 x 0.85 x 8.0). Similarly, the 50 percent range down to the best quarter of the practice and up to the worst quarter would be between $1,220,000 and $2,268,000.

This estimate covers the cost of construction only, which usually represents 80 to 85 percent of the total bonded project cost, the other incidentals comprising preliminary expenses, land, engineering, legal, and interest during construction.

The most probable figure serves as the yardstick. If it is definitely known that unusually difficult or exceptionally favorable construction conditions prevail at the site the most probable cost accordingly would be adjusted upward or downward. Otherwise, the direction and extent of the deviation from the most probable cost is determined primarily by economy in design.

TABLE 1—DISTRIBUTION BY STATES OF PLANTS WHOSE COSTS WERE USED

State	Number	State	Number
Connecticut	3	New Jersey	23
Illinois	42	New York	28
Indiana	8	Ohio	24
Iowa	6	Pennsylvania	13
Maryland	5	Rhode Island	3
Massachusetts	6	South Dakota	1
Michigan	10	Wisconsin	10
Minnesota	2		
New Hampshire	1		185

TABLE 2—DISTRIBUTION OF PLANTS BY TYPE

Type	Allowed Efficiency	Number
Primary	35%	54
Intermediate		
Chemical Coagulation	65	22
Complete		
Trickling Filter	85	57
Activated Sludge	90	49
Other		3
TOTAL		185

Where curves may be used

The unit-cost curves are a representative sample of demonstrated American practice in northeastern and central United States, and as such serve as a yardstick to engineers and public officials in evaluating pollution-abatement programs in that region. The curves are not intended to supplant a detailed engineer's estimate, but they may be a useful guide to designers in keeping costs in line.

During the promotion phase of a project prior to the availability of construction plans and specifications from which detailed estimates can be made, such curves are of greatest usefulness. In this phase, more than any other, reliable norms of cost are needed: first, to evaluate various schemes and crystallize the most economical solution; and second, to establish advance programming of works and sound financing.

The writer gratefully acknowledges the assistance of Donald Larkin, Francis Sheridan and Francis Costa in tabulating and computing, and particularly Harriet Velz in painstaking library research.

Two State Highway Departments Offer Special Training Programs

In an effort to interest more young engineers in highway work as a career, two state highway departments have gone beyond the earlier practice of seeking engineering students for summer work and now offer definite training programs. Details of these are given in a recent statement by Mr. Charles Upham, engineer-director of the American Road Builders Association.

"Virginia has had two programs for obtaining young engineers in action for the last three years. One is an in-training program wherein veterans work with the department while they pursue their engineering studies either at night school or by correspondence under the provisions of the G. I. Bill.

"The highway department also employs graduate engineers who stood in the upper half of their classes. They are paid a salary of $250 a month plus $35 subsistence while undergoing a three year training program—six months of each year is spent in one of six phases of highway work. At the completion of the term, these young men are qualified for positions as administrative engineers with the department.

"Kentucky recently announced a new scholarship plan, conceived to bring more young engineers into the state highway department. Under the program, Kentucky is offering $500 scholarships to 18 first-year engineering students, the choice to be made by competitive examination.

Students will pay their own expenses at the college and receive $60 a month during the freshman year. Besides college work, the students will be employed during the summer by the highway department in various phases of highway work. The entire training period will cover six years at the completion of which the student will have received his bachlor of civil engineering degree and will have three years of experience."

Incinerator Practice—1910 and Today

Similar-size installations at Milwaukee and Winnipeg, built almost four decades apart, furnish interesting comparisons relating to design factors, costs and procedures in taking bids.

Samuel A. Greeley and **Samuel M. Clarke**
Partners in Greeley and Hansen, Consulting Engineers
Chicago, Ill.

THIRTY EIGHT YEARS AGO, the senior author was engineer in charge of construction and superintendent of operations at the Milwaukee refuse incinerator. Recently, he and the co-author, as partners in the firm of Greeley and Hansen, were consulting engineers on the Winnipeg, Canada incinerator. Since there were some things in common between these two installations, although separated by a long period of time, the opportunity afforded itself to reflect on incinerator practices in 1910 as compared with those that prevail today. Of special interest are the bases for design and procedures in taking bids.

The Milwaukee plant, which went into operation on May 12, 1910, has been successful in its performance and is still in use. The Winnipeg incinerator began routine operations on February 12, 1948, construction having been started two years earlier.

The plants are similar in size, the rated capacities being 300 tons per 24 hr. In the Winnipeg building, however, space is provided for installation of another 100-ton unit.

One of the major differences lies in the character of refuse on which the capacities and designs were based. At Milwaukee these included ashes and manure, as follows:

Type of Material	Percent by Weight (Average Annual Refuse)
Garbage	41
Household Ashes	41
Rubbish	5
Stable Manure	13

At Winnipeg, the design provided for garbage and rubbish only. The specifications defined mixed refuse as having 55 per cent of moisture by weight and a heating value of 7,000 Btu. per lb. of dry solids. This approximates refuse containing 65 per cent garbage and 35 per cent rubbish.

In the intervening years, the characteristics of the refuse actually burned at Milwaukee have come to be much like those at Winnipeg.

The Milwaukee plant comprises four rectangular furnace units each

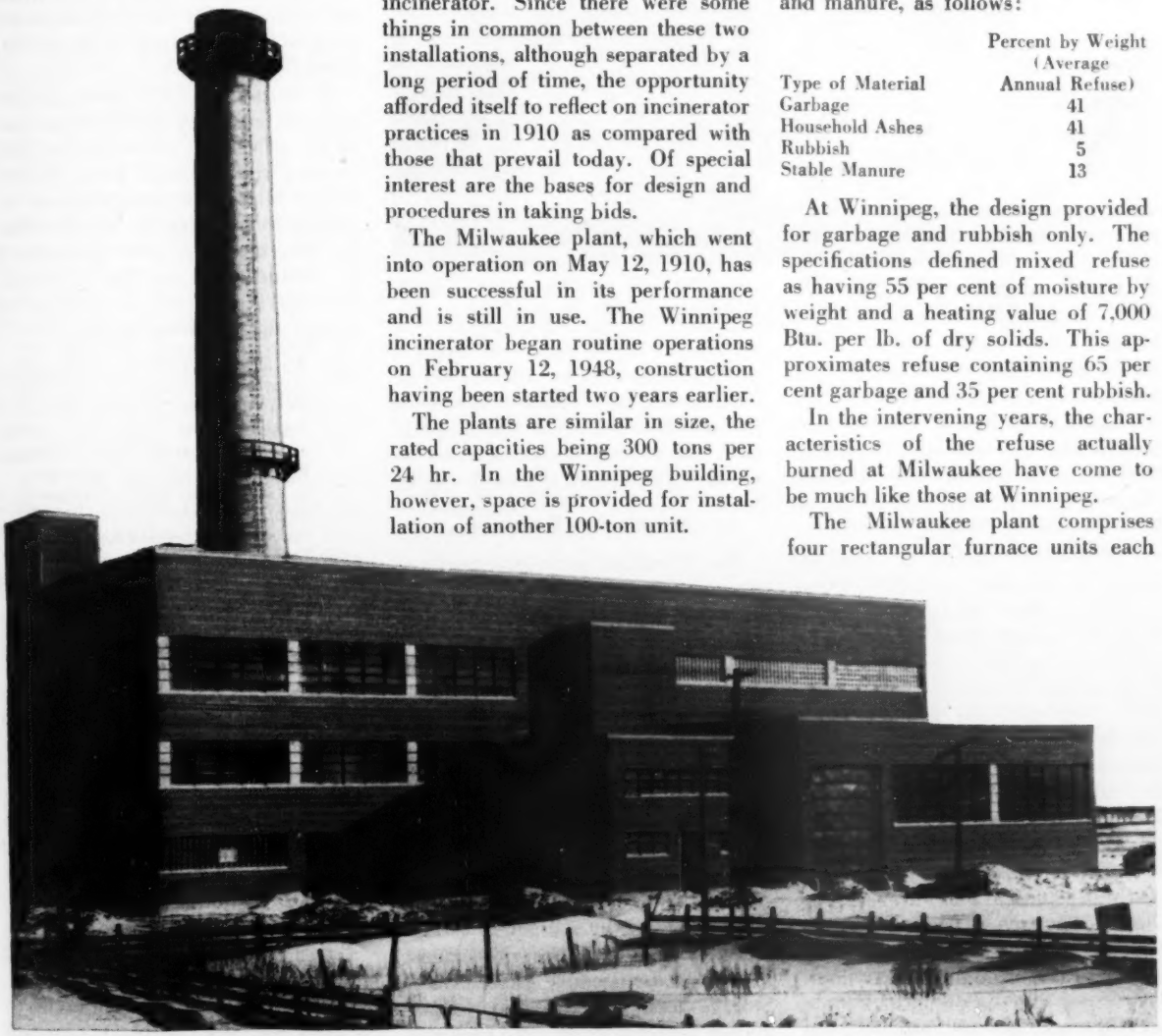


FIG. 1. WINNIPEG'S REFUSE-INCINERATOR building houses three 100-ton circular furnace units and includes space for a fourth. Chimney is 175 ft. high.

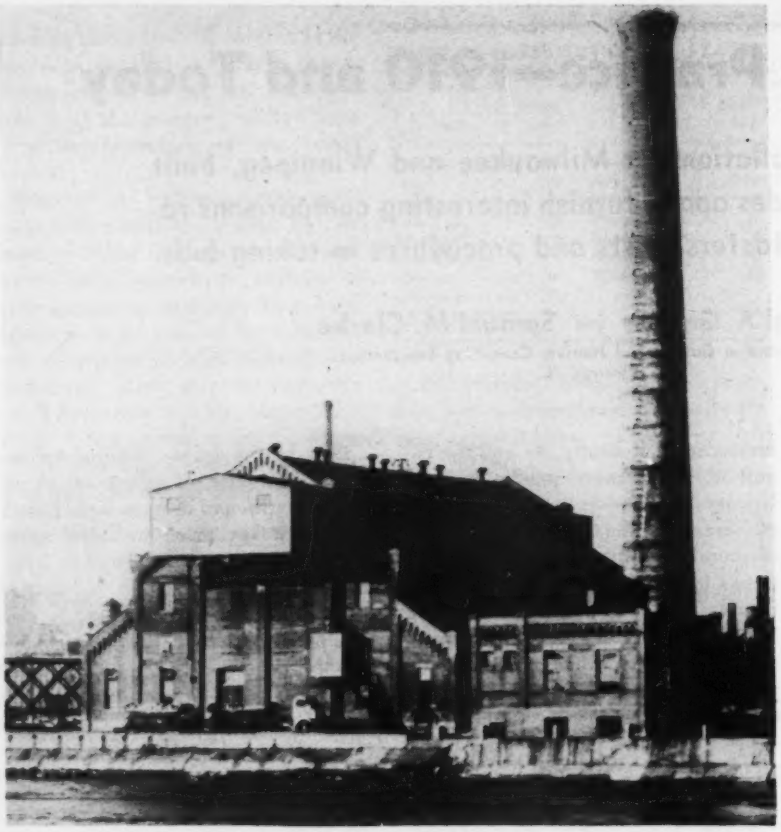


FIG. 2. MILWAUKEE INCINERATOR, which first went into operation in 1910, includes four rectangular furnaces of 75-ton capacity. The plant is still in use.

with a 24-hr. rated capacity of 75 tons. Waste gases from each furnace pass through a 200 hp. boiler. Each furnace has six grates, three on each side of a central combustion chamber. Furnace units are served by a single chimney 165 ft. high and 10 ft. inside diameter at the top.

Storage for refuse is provided above the furnaces and boilers. Originally the refuse was lifted by cranes from the ground level in removable collection wagon or truck bodies or in large steel boxes. The cranes have since been provided with clamshell buckets that transfer refuse from small bins at ground level into which the collection vehicles are dumped. Total storage volume is 550 cu. yd., or 1.83 per ton of rated capacity.

Refuse is raked by hand from the overhead storage bins to charging chutes over each furnace grate, the discharge being controlled by sliding gates operated from the stoking floor. The forced draft is pre-heated.

Clinker and ash are removed from each grate by hand and drop through a trap door in the stoking floor into an ash car in the basement, which is pushed by hand to an adjacent dump.

Although some changes have been made to improve the details of operation, the general design features of the Milwaukee plant remain the same.

Facilities at Winnipeg

The Winnipeg plant includes three circular furnace units each with a 24 hr. rated capacity of 100 tons, with space provided for a fourth unit. No boilers are installed. The furnaces are the Nichols Engineering and Research Corp. Monohearth type with revolving arms and center cone. The single chimney serving the four units is 175 ft. high and 12.5 ft. inside diameter at the top.

All refuse storage is at ground level at one end of the building where there is an enclosed tipping floor. Refuse is lifted by a crane to receiving hoppers over the charging chutes, of which there is one to each furnace. Storage volume is 1,000 cu. yd., or 2.5 per ton of ultimate rated capacity.

There is no manual handling of the refuse except that an attendant on the charging floor removes spillings and otherwise keeps the floor clean. Charging chutes over each furnace are controlled by pneumatically operated sliding gates operated from the stoking floor. Forced draft is pre-heated.

Clinker and ash are removed from each furnace through dumping grates and drop into an ash hopper below, where they are quenched. A sliding gate on the hopper controls the discharge of quenched ash into trucks for removal to a dump.

Procedure for bidding

In both projects, bidders were required to guarantee certain items of operating cost and other factors, and bids were compared on the basis of a computed total annual cost. Tests were specified and made to determine the fulfillment of the guarantees and both of the incinerators successfully passed these tests.

At Milwaukee, the lowest bidder was determined by adding 10 per cent of the price bid for furnishing and erecting the furnaces, flues, boilers, cranes, scales and appurtenances, including foundations, to 100,000 times the net operating cost guaranteed for incinerating one ton of refuse. This operating cost was specified to include the following items:

(a) All labor required to operate the plant from the time the refuse has been dropped into the storage hoppers until it is deposited as ash and clinker outside the building. Rates of pay for labor were specified at $3.00 per day for engineers, $2.00 per day for feeders and stokers, and $1.50 per day for laborers.

(b) The value of the steam used to operate the furnace and boiler auxiliaries, computed at 4 cents per pound.

(c) A credit for the value of all steam generated, computed at 4 cents per pound.

It should be noted that the foregoing method of evaluation takes no account of the cost of the building superstructure. In Table 1 is shown a tabulation of the four bids received.

At Winnipeg, the lowest evaluated bid on the furnaces and appurtenance was determined by adding the following items:

(a) Six per cent of the lowest bid for the building.

(b) Twenty per cent of the bid for the furnace equipment.

(c) The guaranteed number of men per shift on the stoking floor multiplied by $5,400.

(d) The guaranteed number of kilowatt hours per ton multiplied by $500. This included only power for the operation of the incinerator units, and excluded the crane, lighting, etc.

(e) The guaranteed pounds of coal per ton multiplied by $20.

In the case of Winnipeg, the cost of the building was included in the evaluation. A summary of the bids at Winnipeg is shown in Table 2.

In both projects, the specifications required the bidders to guarantee certain operating factors. For Milwaukee, these are summarized as follows:

(1) That no nuisance is created in the ordinary operation of the plant.

(2) That no odors, obnoxious gases, smoke or dust escape from the chimney or building.

(3) That at no time during normal operation the temperature in the combustion chamber falls below 1,250 deg. and that an average of at least 1,500 deg. is maintained.

(4) That the residual from the furnaces is thoroughly burned, hard, and free from organic matter.

(5) That the flues, dust collectors, furnaces and combustion chambers are so arranged that it shall not be necessary to shut down any unit for more than 48 hours to thoroughly remove dust and ashes.

(6) That the pounds of refuse incinerated per square foot of the grate area upon which final combustion takes place shall not be less than stated in the bid.

(7) That the average rate of evaporation in the boilers shall not be less than stated in the bid.

(8) That the average cost per ton for incinerating the average annual refuse shall not be more than stated in the bid.

For Winnipeg, seven guarantees were required. Under the first guarantee, the capacity of each furnace unit was specified to be 100 tons per 24 hr. As compared to similar guarantees at Milwaukee, those at Winnipeg are somewhat more specific, as for instance, the guarantee that no smoke will escape from the chimney top having a degree of darkness greater than that determined by chart No. 1 of Ringleman's smoke rings.

The temperature guarantees were lowered to a minimum of 1,100 deg. and an average of 1,400 deg. Specifications for the residue from incineration at Winnipeg call's for a guarantee that it contain no more than two per cent of organic matter exclusive of carbon. Other guarantees related to the number of men required for direct operation of the incineration equipment, electric power per ton of refuse, and the number of pounds of coal per ton of refuse.

In general, however, the specified guarantees were not greatly different.

For each project the specifications required that tests be made to demonstrate the ability of the incinerators to fulfill the guarantees.

At Milwaukee it was specified that each of the four units would be tested once, each test to last for five days of 8 hours. Various kinds of refuse were specified to be used for each of the tests to represent the average annual, the extreme summer, and the extreme winter refuse. In general, the specifications provided that if the plant did not fulfill the guarantees in the tests the contractor would remove the furnaces, combustion chambers, and all incinerator appurtenances and return all monies paid on account for these structures.

An adjustment was provided, how-

TABLE I—TABULATION OF BIDS RECEIVED AT MILWAUKEE

Bidder	I*	II	III	IV
Furnace and equipment	$174,384	$175,371	$150,782	$174,987
Guarantees				
Cost per ton for labor and steam	$0.476	$0.847	$0.43	$0.73
Value of steam produced per ton	0.88	1.16	0.60	0.80
Net revenue per ton	0.404	0.313	0.17	0.07
Evaluation				
10% of furnace bid	$17,438	$17,537	$15,078	$17,499
100,000 x net revenue per ton	40,400	31,333	17,000	7,000
Net revenue	22,962	13,796	1,922	.....
Net cost	.....	.....	.....	10,499

Note: * Awarded Contract.

TABLE II—TABULATION OF BIDS RECEIVED AT WINNIPEG

Bidder / Type of Furnace	I	II		III		IV
	Square	Square	Circular	Square	Circular*	Square
Lowest building bid	$449,998	$449,998	$435,850	$449,998	$435,850	$449,998
Furnace and equipment	208,810	243,600	203,000	220,460	219,990	201,440
Guarantees						
No. of men per shift	3	4	1	4.5	2	3
Kwh. per ton of refuse	4.16	18.6	18.6	2.39	2.85	4.16
Lb. of coal per ton of refuse	0	0	0	0	0	0
Evaluation						
6% of building bid	27,000	27,000	26,151	27,000	26,151	27,000
20% of furnace bid	41,762	48,720	40,600	44,092	43,998	40,288
No. of men @ $5,400	16,200	21,600	5,400	24,300	10,800	16,200
Kwh. per ton @ $500	2,080	9,300	9,300	1,195	1,425	2,080
Lb. of coal per ton @ $20.00	0	0	0	0	0	0
Evaluated bid	$87,042	$106,620	$81,451	$96,587	$82,374*	$85,568

Note: * Awarded Contract.

TABLE III—COMPARISON OF BASES OF DESIGN OF REFUSE INCINERATORS AT MILWAUKEE AND WINNIPEG

Item	Design Data Milwaukee	Winnipeg
Rated capacity—Tons per 24 Hr.		
Buildings	300	400
Furnaces	300	300
Storage bin, cu. yd. per ton of capacity	1.83	2.50
Volume, cu. ft. per ton of capacity		
Furnaces	18.2	9.0
Combustion chambers	12.0	16.0
Total	30.2	25.0
Inside depth of furnaces, ft	8.62	.....
Diameter of furnaces, ft	.....	11.7
Rate of burning, lb. per hour per sq. ft. of inside horizontal furnace area	51.0	78.0
Area of chimney top, sq. ft. per ton of capacity	0.26	0.31

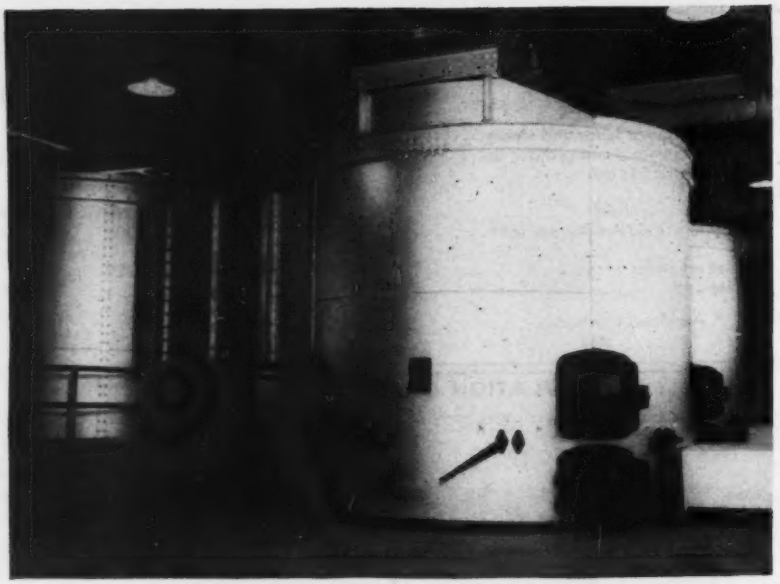


FIG. 3. A CIRCULAR FURNACE and combustion-chamber unit at the Winnipeg plant. Refuse enters the furnace (right) through an overhead chute from the charging floor above.

ever, if the actual cost of operation exceeded the guaranteed cost by less than 15 per cent. Under this condition, the specifications provided that "there shall be deducted from monies due the contractor a sum equal to the present worth of a capital representing the cost over and above the guaranteed cost of incineration for a period of three years, the amount being computed at 6 per cent and for 300,000 tons of refuse."

At Winnipeg it was specified that the plant would be tested for a period of four weeks, during which period each furnace unit would be tested for a period of three days. During each three-day period, one period of six hours was chosen, during which precise measurements were made of the quantities and characteristics of the refuse and of all other items covered in the guarantees.

If, under the specified conditions, the plant failed to meet the requirements of the specifications and the guarantees, the contractor was required to remove all of the incineration equipment, such as the furnaces, combustion chambers, and appurtenances, and to refund to the city all monies paid on account of such work. The Winnipeg specifications provided no adjustment for a failure to meet the guaranteed cost of operation as at Milwaukee.

Layout of the two incinerators provides interesting comparisons relating to the following: (1) Location and size of the storage or receiving bins; (2) facilities for removing fly ash and dust; (3) ash-removal facilities; and (4) the general plan of the furnace and stoking rooms.

At both plants, storage or receiving bins are so located as to permit the furnace and stoking rooms to have windows and doors on three sides. At Milwaukee, however, the bins are over the furnaces and at Winnipeg they are at one end of the plant. At a number of incinerators, the receiving bin is along one side of the furnace room and the stoking room is apt to be dark and hot. The general plan at Winnipeg is considered to be good.

The ash-removal floor at Winnipeg is at street elevation and ample facilities are provided for the entrance and exit of trucks. At Milwaukee, the ashes were removed by cars of the industrial type operating in a basement below street elevation.

At Winnipeg, the flues leading to the chimney were considerably extended in length and area and have proved to be effective in removing fly ash and dust. At Milwaukee, fly ash and dust are removed from the waste gases in passing along the combustion chambers and flues and through the boilers. At both plants the discharges from the chimney tops have been quite free of objectionable fly ash.

At both plants, ample and satisfactory clearances for stoking have been provided. The clear width in the furnace room at Milwaukee is 13 ft. At Winnipeg it is only 8 ft. because shorter stoking tools may be employed with a circular furnace.

The bases of design of the two projects are shown in Table 3. It will be noted that the capacity of the storage bin is considerably larger at Winnipeg. Also, the total unit volume of the furnaces and combustion chambers at Milwaukee is greater than at Winnipeg, the larger part of the increase being in the furnace volume. The chimney at Winnipeg is higher and larger than the one at Milwaukee.

The unit rate of burning at Winnipeg, at rated capacity, is considerably higher than at Milwaukee. This is considered to result from the mechanical stoking, the more efficient distribution of combustion air, and the quicker removal of ash.

Comparison of costs

The following brief comparison of the construction costs of the two refuse incinerators is of interest.

Item	Milwaukee	Winnipeg
Year of bids	1909	1946
ENR Construction Cost Index	96	330
Cost per ton of rated capacity		
Building	$181	$1,090
Furnaces	348	733
Boilers and generating equipment	140	...
Chimney	15	112
Total	$684	$1,935
Total, excluding boilers and generating equipment	$544	

In the foregoing tabulation the unit cost of the building and chimney at Winnipeg are computed on the basis of a rated capacity of 400 tons and all others on 300 tons, both per 24 hr. The ratio of the construction costs, excluding boilers and generating equipment at Milwaukee, is 3.56 as compared to a ratio of the index of about 3.44. It should be noted that the unit cost of the furnaces and appurtenances at Milwaukee includes an amount of $140 per ton for boilers and generating equipment, which are not in the Winnipeg costs.

At both Milwaukee and Winnipeg, the specifications for refuse incinera-

tors required certain guarantees including the cost of operation. The bids received, four in each case, were compared on the basis of a computed or evaluated annual cost. At Winnipeg, differences in building costs for different types of incinerators were taken into account, thus resulting in a more complete comparison.

The general plan or arrangement of the plant at Winnipeg is much better than at Milwaukee. This results in better working conditions and a lower operating cost, although the lower cost results in part from the semi-mechanical operation of the furnaces at Winnipeg. The total number of persons allotted to the operation of the two plants—31 at Winnipeg and 45 at Milwaukee—although not conclusive, is an indication of the general effect of the improved design at Winnipeg.

It should be noted that a few of the men on the payroll at Milwaukee are required on account of the boilers. It is pertinent, however, to comment on the differences in the two incinerators as regards the number of operators. The Milwaukee plant comprises eight furnace units and twenty-four separate grates, all charged, stoked, and freed of ashes by hand, as contrasted with three such units at Winnipeg, all having some mechanical operation. Each of the four units at Milwaukee having a 24 hr. rated capacity of 75 tons comprises two furnace units of three grates each located on either side of a common combustion chamber. Thus, at Milwaukee twenty-four charging chutes are filled by hand from the storage bins, whereas at Winnipeg there are only three charging chutes, and these are filled by a crane.

Furthermore, at Milwaukee ashes are removed from the building by hand pushed cars, whereas at Winnipeg they are discharged through dumping grates directly into trucks for removal. There are eight dumping grates in each furnace at Winnipeg. These are important differences.

The bases of design for the two projects are somewhat similar as regards general objectives, but when compared as in Table 3 show the results of operating experience over the years. There are no major errors or bottlenecks in the bases of design at Milwaukee and for a generation and a half it has disposed of mixed refuse in a satisfactory manner.

The incineration plant at Winnipeg is attractive, not only in appearance inside and out, but also to operate. Good features are the general plan, with the storage bin at one end instead of at the side of the building, the ash floor at ground elevation, and the enlarged flues for the removal of fly ash.

Nuclear Fission Developments Pose Sanitary-Engineering Challenge

PROTECTION of man and his environment against the hazards of radioactivity adds to the responsibilities of the sanitary engineer, and he should acquaint himself with the problems which this new industry will bring, especially in the disposal of its wastes to the atmosphere, to the soil, or to surface waterways. These are the views of Abel Wolman and Arthur E. Gorman, consultant and sanitary engineer, respectively, of the Atomic Energy Commission.

In a joint address before the Kentucky-Tennessee Industrial Waste and Sewage Works Association in Chattanooga recently they pointed out that the Atomic Energy Commission recognizes the need of complete control over the various environmental factors which concern and affect this new and unique industry. Many of the areas of vulnerability in the atomic-energy field that affect environmental sanitation are those in which the sanitary engineer is especially trained to help. As the industry grows, there will be an increasing need of assistance from sanitary engineers, both at atomic-energy plants and in areas surrounding them. The need of special training of sanitary engineers in nuclear physics is a pressing problem and one which is currently the subject of much discussion.

Studies already under way

Of special interest to sanitary engineers, said the author, are the following studies initiated by the AEC:

Meteorology — At the Hanford Works in Washington experiments have been carried out to determine the most favorable atmospheric conditions under which to carry out operations. At several other AEC areas such studies and controls are planned, notably at the Brookhaven National Laboratory in Long Island, N. Y. The use of treatment devices, such as filters, scrubbers and electronic facilities adapted from experiences in other industries, in addition to stacks, are a part of the planned program for elimination of radioactive particles. Cooperation of the U. S. Weather Bureau has been secured to assist in studies of atmospheric problems.

Groundwater Protection—U. S. Geological Survey Cooperation has been requested in studies and evaluation of surface and subsurface contamination of water supplies where radioactive and toxic wastes may be discharged into or onto the ground. Such problems are currently being given consideration at the Hanford Works and in planning operations at several other locations.

Site Selection—Consideration of environmental conditions and potential hazards is being given in the selection of all sites for new production and research plants. These include hazards of normal operation and those which might result from damage to facilities in case of an emergency.

Waste-Disposal Research—Plans are being made to develop additional methods of disposal of radioactive and toxic wastes, both gaseous and liquid. Experts of the U. S. Public Health Service as well as research technicians on the staff of industry and universities are studying these problems.

Disposal of bulky equipment and materials which through long and continuous use have become contaminated by long-life radioactive substances, and therefore must be replaced, is a difficult problem that is also under study.

The effect of radioactive materials on piping in buildings, sewers and

facilities is scheduled for study along with the influence of such materials on standard processes of sewage treatment.

Problems of water supply

In connection with water supply, the authors had this to say:

Recognizing that disposal of radioactive or toxic wastes from its plants or research operations in increasing quantities could create serious problems, the Atomic Energy Commission and its various area contractors have given much consideration to reducing such contamination to an absolute minimum. For example, a water-cooled reactor requires a large volume of water for heat-exchange purposes, and this water must be disposed. The type and degree of radioactivity in such water can be determined and controlled. Knowing the radioactive characteristics of the water leaving the reactor, the period of time it will continue to emit nuclear energy can then be determined. Furthermore, through the knowledge of the amount of this energy in particles or radiations that the human system can tolerate with safety, it is possible to determine the extent of hazard involved in waste disposal.

Since all radioactive substances undergo decay until they cease to emit energy, knowledge of the length of time required for this decay provides one method of appraising the extent of the problem. By storing waste long enough, it would be possible to reduce the hazard of its energy when released.

Consequently, storage is one method of treatment relied upon in the case of cooling water returned to streams. Unfortunately, some radioactive substances have long half-lives. In such cases, these substances must be removed from cooling water.

At atomic-energy plants there is always the remote possibility that an accident or a spill will occur with the result that the waste products in abnormal amount might be released. Great care is taken to avoid such accidents and provision is made for special treatment and duplicate equipment should they occur. Nevertheless, it should be the concern of every sanitary engineer responsible for water supply in an area where nuclear-fission products are produced or used to appraise and evaluate risks to such supplies under all circumstances. He should work out with operators of such plants a system of routine checks and warnings.

Discharge of radioactive waste products into or onto the ground also has potentialities for contaminating water supplies. Here again, long known principles of disposal of waste from industrial plants apply. Radioactive waste products with long half-lives could create serious hazards and their discharge deserves careful study and control. Where such wastes are disposed into the soil, it is of basic importance that information be obtained as to the rate of flow of the groundwater and the dilution possibilities so that at all times the extent and degree of contamination may be known.

There is some evidence that such processes of water purification as coagulation and sedimentation and sand filtration are quite effective in removing radioactive substances from water. The problems of disposal of the radioactive sludge in controlling the build-up of radioactivity in filter media deserve consideration.

Radioactive particles carried into the atmosphere by gaseous effluent from nuclear-fission operations could contaminate the air we breathe and, on settling with or without rainfall, contaminate the soil and vegetation on which they deposit. Thus, watersheds and open reservoirs could become contaminated if the half-life of the radioactive products is long. Here again the element of time and dilution as well as fixation are factors of safety.

Still another aspect of radioactivity in water, interesting and significant to sanitary engineers and biologists, is evidence that such energy does not affect many plankton growths and is accumulated within these organisms. Algae and other forms are known to grow prolifically in water which is quite radioactive.

Problems of waste treatment

Many operators of sewage treatment plants are concerned that with the more extensive use of radioactive isotopes at research laboratories and institutions, such as hospitals, wastes may be introduced to public sewer systems which might affect the biological processes depended upon for treatment.

In the light of experiences in many cities where wastes from new industries, when discharged into public sewers, seriously affected such process, this concern is not surprising. Research on pilot plant scale to determine this effect in the case of nuclear-fission products has been arranged at two AEC areas.

Should it develop that there is no effect on biologic processes, other than concentration of radioactivity as indicated in the case of plankton forms in water, the principal concern would be in radioactive contamination of facilities exposed to the wastes as well as sludge which may be dried and used for fertilizer.

Storage of sludge in basins and digesters will permit decay of much of the radioactivity of many of the common isotopes; but in the case of some of the long-life ones, such as C-14 with a half-life of 5,100 years, the normal storage period would be insignificant and ineffective.

Techniques and tolerance limits

In any consideration of contamination, scientists are accustomed to make use of certain standards or permissible tolerance levels. Sanitary engineers already need some guide as to the relative degrees of radioactive contamination, techniques for their measurements and safe limits for public safety and health. The radiologist and the health physicist have done much to develop such techniques, standards and equipment.

By means of instruments such as electroscopes, Geiger counters and ionization chambers, they evaluate the raidoactive energy from nuclear particles, such as alpha and beta particles and gamma radiation. They have made much progress in developing instruments of increasing sensitivity and accuracy. Much more work along these lines has to be done before the sanitary-engineering profession has the tools it needs.

Conclude the authors: When one considers the potentialities of wartime hazards involved in the field of atomic energy, whether in production for military purposes or the possibility of enemy action, the importance to the national defense of having a large number of sanitary engineers trained in ways and means of coping with hazards of nuclear fission products is evident to a sharp degree.

BUSINESS AS USUAL in wintertime, because . . .

Lansing, Michigan, Removes all the Snow

EVERY TIME IT SNOWS more than 4 in. in Lansing, Mich., city snow-fighting crews pick up all the snow from eight miles of downtown streets, bus routes and state trunk lines—equivalent to an 80-acre area—haul it away and dump it into Grand river. And they usually do it in three to seven days.

When the snowfall exceeds 6 in., the remaining 186 mi. of city streets are plowed, some 300 mi. of residential sidewalks are cleaned with V-plows mounted on tractor or jeep and, if the next storm does not hit too soon, most of the alleys are plowed.

Removing 80 acres of snow from 4 to 8 in. deep is a large order for a city the size of Lansing, with its 90,000 population. But considering that some winters the city is blanketed with a total of 70 to 80 in., the task of removing 750,000 cu.yd. of snow seems incredible.

Relatively little snow-fighting equipment is used both for straight plowing and for plowing, loading and hauling. Current inventory, exclusive of that used for ice control, includes 16 10-ft. plows mounted on 3-ton trucks and motor graders, one Model LMU Snogo, seven 10-yd. trucks for hauling and 26 sidewalk V-plows. Three more street plows are to be added to the fleet this winter and eventually the total number will be increased to 24.

Organization, timing and teamwork

As in any successful battle against improbable odds organization, timing and teamwork are the secrets of Lansing's snow-beating record. In fact, the plowing by day and removal by night leaves many a citizen with the impression that the snow has simply evaporated over night.

First operation at the start of any snow storm is to apply bulk rock salt by mechanical spreaders to all dangerous intersections, downtown streets, and bus and arterial routes. This keeps traffic moving, prevents packing, and forms a slush which facilitates removal of the snow if the storm worsens.

Plowing starts when 4 in. of snow has fallen. Streets are plowed both ways from the center line, into windrows 8 to 10-ft. wide and 5 to 6-ft. high near the curbs. One crew is kept busy clearing the snow manually from around parking meters and hydrants.

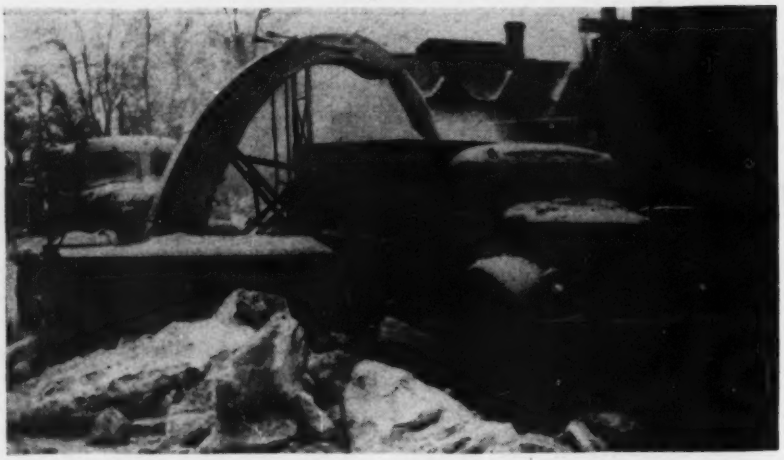
The greatest single impediment to plowing and removal of the snow is the ubiquitous "parked car". During daytime storms this permits only partial plowing, with final plowing possible only after the downtown parked cars have dispersed for the night.

If the snow falls during the daytime, the streets are plowed but removal is not begun until after midnight. Even at this late hour two men and a tow truck are kept busy clearing the street of cars. City policemen render valuable assistance at this stage of operations both in directing traffic as a safety measure and serving as a bulwark between the tow truck crew and an occasional irate citizen whose automobile is being unceremoniously removed from its position at the curb.

Night plowing

If a heavy snowfall begins in the evening, plowing continues through the night but loading and hauling of snow in the business district is delayed until the second night to permit business establishments to remove the snow from their sidewalks into the street. Sidewalks in the downtown area are not plowed, chiefly because of the many areaways beneath the sidewalks.

FINAL PASS of a 10-ft. plow completes the windrow ahead of the snow loader, while city policeman keeps the traffic moving.



EVEN CAKED SNOW is chewed up by the Snogo and discharged into trucks for hauling to the river. Far side of truck bodies have extra 12-in. freeboard to protect passing cars.

SNOW PLOWS windrow the snow in the street but hand-shoveling is the best method found for cleaning around parking meters.

During all snow storms exceeding 4 in., the crews work 17 hr. per day—from midnight until 5 p.m. Starting at midnight, snow removed from sidewalks during the day, and that adjacent to the curb is plowed into the windrow previously formed along each side of the street by the daytime plowing from center line of street to the lane of parked cars.

This final plowing crew is given a one-hour start over the loader. Then it is a race against time to dispose of as much of the snow as possible before the heavy morning traffic sets in. Loading and hauling occasionally continue during the day.

While daytime loading and hauling is less economical, it offers visual proof to the citizen that his city is striving to clear the streets of snow as rapidly as possible. Then, too, loading operations with the Snogo seems to be a never-ending source of entertainment for the many "sidewalk superintendents" of snow removal.

Snow hauled and dumped

The snow is hauled an average distance of ½-mi. and dumped into Grand river through openings provided in the sidewalk of a centrally located bridge. Warm discharge water from a steam power plant upstream keeps the river from freezing. But the velocity of the river is so low that a 25-ft. pyramid of snow often is built up from the top of the water to the bottom of sidewalk on the bridge. In view of this, four openings for dumping the snow are provided in the bridge sidewalk, and generally two are used at the same time.

Removal of the snow from the 8 mi. of the city's major streets is the most expensive operation in Lansing's snow-fighting program. An average storm of 5 to 8 in. of snow costs from 0.1 to 0.4 cents per sq.ft. for its removal.

Last winter the city spent $92,000 for snow removal, plowing and ice control on its streets and sidewalks, plus $16,000 on state trunk lines through Lansing. Of this latter amount, the city was reimbursed $8,000 by the Michigan State Highway Department. One of the worst winters was 1946–47, when the total snow removal and ice control program cost $120,000.

Chief reason for plowing 300 mi. of sidewalks following major storms is that the citizens of Lansing have been sidewalk snow-removal conscious for many years. In fact, they had sidewalk plows long before street plows.

For the average storm, the 300 mi. of sidewalk are plowed in about 5 hr., using all 26 V-plows. Most of the sidewalk plows are mounted on small industrial, pneumatic-tired tractors. A few are horse-drawn and, last winter, the city tried sidewalk plowing with jeep-mounted plows. This method now is favored as it is faster and the jeeps can be used as light pick-up trucks during the remainder of the year.

Located in the Michigan snow belt, Lansing always has had and always will have a major snow-removal problem. First attention has been given to building up a trained crew and providing adequate equipment. For example, the city had only 5 snow plows in 1942 as compared to 19 for this winter.

STEADY DUMPING of snow into Grand river creates 25-ft. pyramids from top of water to bridge floor, necessitating four discharge holes in the bridge sidewalk.

All left-hand turning

Plowing routes are laid out to permit all left-hand turning. Right-hand turns are avoided and the plows never reverse their direction of plowing in any street if it can be helped. When approaching an intersection preparatory to turning left into a cross street, the plow is taken in close to the curb and turned as sharply as possible. Making a tight turn in this manner spills all snow ahead of the plow over a level area and avoids leaving a big windrow to impede or block traffic.

Of equal importance are the methods developed for coping with each storm as it hits. Years of experience has proved that the best plan for plowing is to always operate the plows in groups of at least two, with enough additional plows on the wider streets—operating in echelon—to complete the plowing for one-half the width of street in one trip.

Rock salt for ice control

For ice control and for melting all snowfalls of less than 4 in. Lansing uses straight bulk rock salt in preference to calcium chloride with or without sand. The city has never used cinders. The use of rock salt exclusively was inaugurated last winter when some 2,000 tons of salt were needed to keep about 80 mi. of streets free of ice.

The use of salt received public approval as it was not tracked into homes and business establishments as much as the previously used abrasives. It did not clog the city's sewer lines as badly as did the sand, and it was cheaper to purchase. Moreover, relatively little damage was done to street pavement since only 8 mi. of the city's streets are paved with portland cement concrete.

Another benefit from using the straight salt is that a thin layer adheres to the pavement to aid in the initial thawing of the next snow that falls. Experience also proved that the continued use of sand in salt or calcium chloride had a serious abrasive action on asphalt pavement at intersections due to the stopping, starting and turning of vehicles.

From an economic standpoint, the bulk rock salt is much cheaper. It is trucked from Detroit, Mich. at a delivered price in Lansing of less than $10 per ton. In comparison, calcium chloride costs from $22 to $25 per ton delivered in Lansing, while the cost of sand has risen from $0.15 per cu. yd. before the war, to $1.00 per cu. yd. delivered at the stockpile, plus $0.75 per cu. yd. for hauling it to the point of application.

Supervising personnel

All snow-removal and ice-control is under the supervision of Glenn P. Manz, director of public service and city engineer. Field operations are under the direct supervision of Collins E. Thornton, assistant city engineer. Also assisting in the work for the past severel years was Palmer H. Slack, formerly assistant director of public service, who recently was appointed city engineer of Benton Arbor., Mich.

Safety Essentials In Designing Water-Recarbonation Systems

Safe operation should be of prime consideration in the design of carbon-dioxide gas systems for stabilization of lime-softened water. As a consequence, special care must be exercised to provide a furnace, scrubber and dryer, compressor and diffusion chamber that will produce and convey gas into the water and then conduct gases coming off the water to the atmosphere without leakage.

Leakage must be prevented, reported Herbert Arnold, engineer of the Lignite Combustion Engineering Corp., Bismarck, N. D., in an address before the North Dakota Water and Sewage Works Conference, because a small amount of carbon monoxide, a lethal gas, is always given off in combustion. Carbon-monoxide gas is particularly hazardous, he warned, because it is colorless, odorless and tasteless.

To minimize carbon-monoxide formation, the furnace should be large enough to assure complete combustion of mixed fuel and air. In addition, the air-fuel ratio should be controlled automatically and motors operating the furnace unit should be in the same circuit as the control system. Mr. Arnold pointed out that this arrangement provides coupled operation and thus eliminates any time lag during which unnecessary quantities of carbon monoxide would be produced.

He emphasized that two parts of carbon monoxide per 10,000 of air are unhealthy and cause headache; one part in 500-750 is extremely dangerous; and 3 to 4-hr. exposure will cause death.

In addition, the size of the furnace is related directly to the percentage of carbon dioxide formed, larger combustion chambers generally producing higher percentages of carbon dioxide.

Most boiler manufacturers, Mr. Arnold reported, recommend volumes of 3 to 5 cu. ft. per lb. of coal burned per hour for production of gas with 15 percent carbon dioxide. This figure should be increased about 30 percent for natural-gas or oil fuels, he said.

Compressor by-pass needed

As the water pressure on diffusers (about 10-ft. head) exceeds that delivered by centrifugal units, positive-displacement compressors are usually employed to draw off and force stack gases through the scrubber, dryer and diffusion system. The quantity of gas handled, therefore, must be regulated either by bleeding air into the compressor intake or by installing a by-pass around the unit. The by-pass, said Mr. Arnold, is probably the simplest solution because the bleed should draw air from the atmosphere to prevent gas leaking into the plant when the compressor is not in operation.

Some gas not absorbed

It was pointed out that a compressor should be large enough to handle 90 percent inert gas. This is so because flue gas will contain 12 to 15 percent carbon dioxide and one to three percent of the gas, not absorbed by the water, escapes in the diffusion chamber.

A spring-loaded, inclosed relief valve should be installed on the compressor discharge and vented either to the stack or gas intake. This device will prevent plugged nozzles, high pressures and leaks caused by closed valves and damage to the compressor mechanisms.

The recarbonation basin should be covered, and the gas escaping from the water should be exhausted by a small centrifugal blower. The blower should be connected in the compressor electrical circuit so that gas escaping from the water is drawn off automatically.

Mr. Arnold pointed out that carbon-dioxide and flow meters are essential in a recarbonation system to determine carbon-dioxide consumption.

Referring to the amount of gas to be used, he said that, from a safety standpoint, "each operator should determine and use the quantity of carbon dioxide he deems best." This conclusion was reported to be based on considerable investigation which included a sampling of operator opinion.

Incidental to safety considerations, Mr. Arnold suggested that fly-ash troubles could be minimized by providing a large area of grating and baffles in the combustion chamber of the furnace.

RESUME OF RECARBONATION PRINCIPLES

LIME-SOFTENED water is usually over-treated with 25-50 ppm. of lime to convert magnesium salts to insoluble magnesium hydroxide. Because of resulting high caustic alkalinity, the treated water should be stabilized to prevent excess carbonates from crystallizing on sand grains in filters as well as forming incrustations in the distribution system. Addition of carbon-dioxide gas first converts calcium hydroxide into a carbonate and then the carbonate is changed to a soluble bicarbonate. At ordinary temperatures the bicarbonate is stable and will not affect filters or distribution mains.

CARBON-DIOXIDE gas requirements may be determined from the formula: Carbon dioxide required (lb. per mg.) = mono-carbonate alkalinity (ppm.) × 0.44 (molecular weight of carbon dioxide relative to calcium carbonate) × 8.34 (weight of water per gallon). For each part per million of excess lime, about 3.7 lb. of carbon dioxide (30 cu. ft. at standard temperature and pressure) per million gallons of water is required. This represents 1¼ lb. coke, 32 cu. ft. natural gas, 0.2 gal. kerosene, or 1.7 lb. lignite coal.

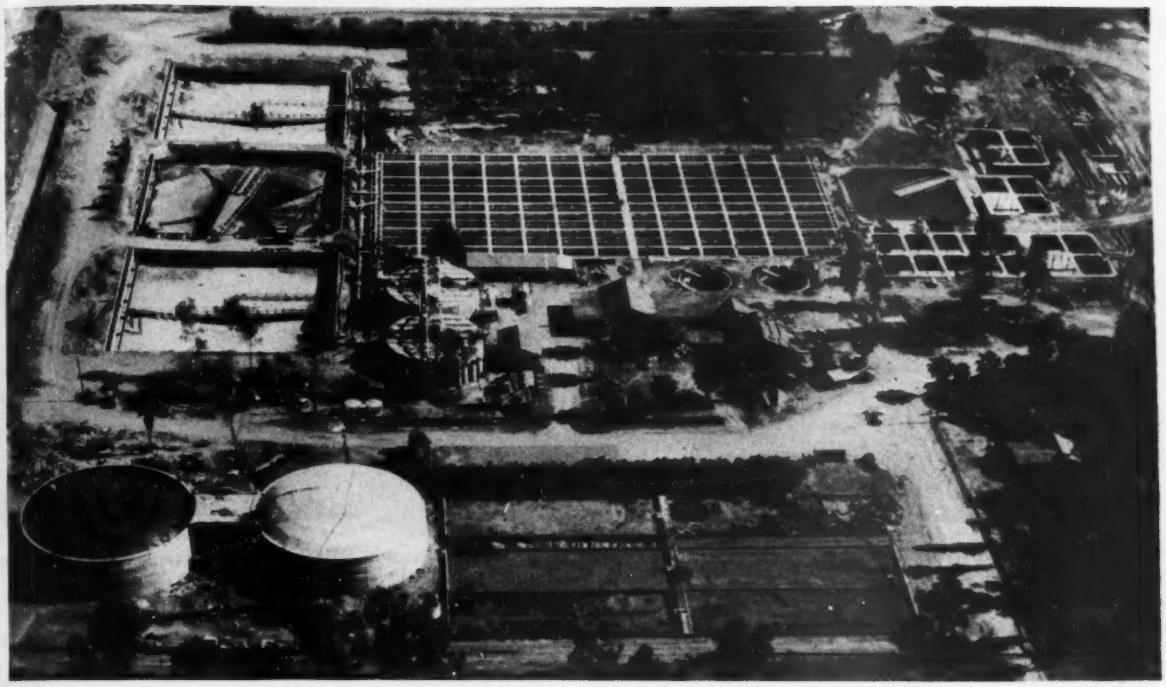


FIG. 1—SEWAGE ENTERS PLANT through grit removers, coagulation basins and primary clarifiers on right. No new capacity added to aerators in center. Secondary clarifiers on left with digesters and sludge beds at bottom. Sludge thickeners are just below aerators.

Enlarging an Activated-Sludge Plant

DOUBLING the capacity of the Phoenix, Ariz., activated-sludge plant has been accomplished without the use of additional aeration tanks. An increase from 12 mgd. to 30 mgd. capacity at average flow was obtained by changing to high-rate spiral-flow aeration and by enlarging other plant facilities. Additional sedimentation and digestion tanks were built and chemical precipitation equipment added. Features of the new plant include autoxidation chemical manufacturing and dual-fuel engines with heat from the cooling water transferred to the digesters.

The old Phoenix plant, placed in service in March 1932, was rated at 12 mgd. capacity and it included six aeration tanks, each 14x26½x330 ft. Rotating paddles with a minimum of air added (0.2 cu. ft. per gal.) comprised the aeration facilities in the original activated-sludge process. However, the paddles proved unsatisfactory and when they wore out during the war they were removed. This resulted in a decreased efficiency of the plant as new compressed air equipment to step up aeration was not available at that time.

It became necessary to enlarge the plant because of the growth of Phoenix during and since the war and because the sewerage system was to be enlarged to serve some 200,000 people. Although capacity of the new plant at average flow is only 30 mgd., a peak flow of 48 mgd. can be reached before bypassing is necessary.

The plant is located on the north bank of the Salt River and the effluent is discharged into the river. As upstream irrigation dams hold most of the water that would normally flow down the river, the plant effluent is diverted by farmers below Phoenix for irrigation use.

Spiral-flow aeration

By use of spiral-flow aeration with a detention period of 4 hours during which time 1.0 cu. ft. of air per gal. of sewage is added, it was found that the aeration tanks built in 1932 were large enough for a 30 mgd. plant. Diffuser tubes of the Chicago Pump Co. type were installed for this purpose along the 330 ft. length of the tanks. To aid spiralling of the flow, deflectors of quarter-circle galvanized iron were installed along the top of each side of each aerator.

To further provide adequate plant capacity, provision is made for chemical coagulation when necessary. By mixing ferric sulphate with the raw sewage (up to one grain per gallon) in a coagulating basin just ahead of the primary clarifiers, much of the colloidal matter is removed. This makes a significant reduction of load on the aeration tanks.

The larger volume of sewage to be handled and the introduction of chemical treatment required construction of coagulation basins and additional primary-sedimentation facilities. Two primary clarifiers were built to augment the one existing basin. Each new clarifier was made equal in capacity to the old one. Also installed were two new secondary clarifiers and additional weir capacity on the exist-

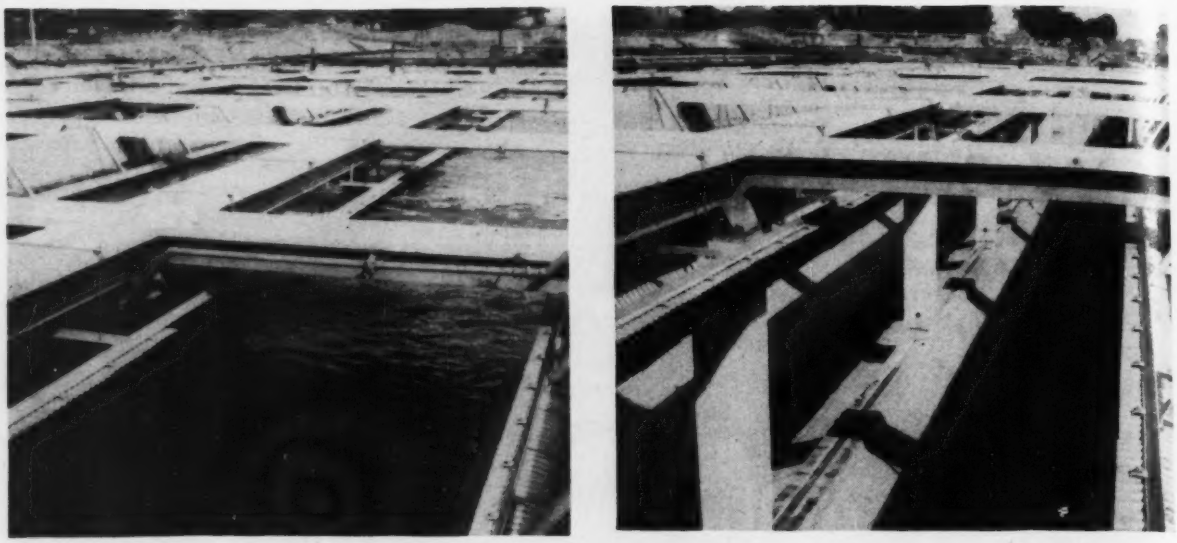


FIG. 2—THESE AERATION TANKS serve the new plant with little modification. Bottom of the tanks were built in the shape of two half circles to accommodate aeration paddles now removed. Corrugated baffles help direct flow.

ing secondary clarifier. Sludge thickening was employed originally and these facilities were doubled.

The original sludge digesters had been troublesome primarily because of overload. This resulted in some damage to them. Accordingly two new digesters were built with capacity sufficient to handle the entire sludge load. It is planned to take the old digesters out of service and repair them, holding them for future secondary digesters.

Other facilities provided for the expanded plant include automatically cleaned bar screens and sewage grinders at the inlet, grit-removal chambers, and Bailey flow meters. A proportioning device was installed to insure equal flow going through each of the three plant segments.

Ferric sulphate for precipitation and ferrous sulphate for odor control are manufactured at the plant by a relatively inexpensive process developed at Phoenix. This process, known as the autoxidation process, requires only sulphur and scrap iron as raw materials. The scrap iron comes from the city dump. With an installation having a 3 to 5 tons per day capacity, chemicals can be produced at Phoenix for about half the normal cost.

DESIGN AND ENGINEERING DATA FOR THE PHOENIX, ARIZ., TREATMENT PLANT

Treatment: Coarse screening, grit collection, chemical manufacturing and precipitation, coagulation, primary sedimentation, spiral-flow aeration, secondary sedimentation, post-chlorination, sludge thickening, two-stage sludge digestion, air drying of sludge, gas recovery for use in dual-fuel engines used for blower operation, sludge heating.

Capacity: 30 mgd. aver., 48 mgd. max., based on probable contributing population of 200,000 when planned extensions of sewer systems are made. Present connected population about 110,000.

Sewage Characteristics: Domestic wastes and some industrial wastes primarily from fruit and vegetable packing. Suspended solids averages 200 ppm. and BOD. 160 ppm.

Bar Screens: ¾ in. openings, Link Belt mechanically cleaned bar screens, Jeffrey grinders, ground screenings returned to flow.

Grit Removal: Two 60 x 10 ft. chambers with Link Belt continuous straight-line grit collection.

Chemical Manufacturing: Ferric sulphate for precipitation and ferrous sulphate for odor control made by autoxidation process.

Coagulation: Three 63 x 45 ft. chambers with air agitation with max. air requirement 0.1 cu. ft. per gal. Time of retention 30 min. at 30 mgd. flow. Dosage of ferric sulphate varies from zero to one grain per gallon.

Primary Sedimentation: One existing 85 ft. Dorr Squarex clarifier and two new 63 x 114½ ft. clarifiers with continuous scraping. Overflow rate 1,400 gal. per sq. ft. per day.

Aeration: Six existing tanks 14 x 26½ x 330 ft. each. Tube diffusers with spiral-flow aeration. Quarter-circle deflectors at tank top helps spiral flow. Detention period 4 hr. for 30 mgd. flow. 1.0 cu. ft. per gal. of air provided. Return activated sludge varies from 10 to 20 percent.

Secondary Sedimentation: One existing and two new 140 ft. sq. Dorr clarifiers. Overflow rate 500 gal. per sq. ft. per day.

Chlorination: 2 chlorinators, each 1,400 lb. per 24 hr. capacity. Effluent channel 100 ft. long by 88 sq. ft. cross section used for chlorine contact.

Odor Control: Ferrous sulphate used at plant when ferric sulphate not added for coagulation. Ferrous chloride used at several points on sewer system.

Sludge Concentration: One existing and one new 35 ft. dia. Dorr thickener. Activated sludge thickened to 2½ to 3 percent. Effluent returned to primary sedimentation tanks.

Sludge Digestion: Two existing 60 ft. dia., 23 ft. deep tanks. Two new 90 ft. dia., 30 ft. deep tanks with fixed dome on primary and floating gas collector on secondary. New units have capacity of 2 cu. ft. per capita for 200,000 design population with a digestion period of 30 days at 85 dg. F. Heat from dual-fuel engine cooling. Old digesters will be used for future secondary digestion.

Drying Beds: 10 acres with no under drains. Earth dike partitions. Annual average rainfall 7 in., evaporation 45 in.

Dual-fuel Engines: Two 265 hp. Worthington dual-fuel (sludge gas and diesel oil) engines. Cost: $500,000 new in 1932. $1,000,000 for recent revisions and capacity increase.

FIG. 3—CHEMICALS ARE PRODUCED from scrap iron and sulphur. Open tanks indicate lack of obnoxious fumes.

By using gas from the digesters to start crude sulphur burning, sulphur dioxide is produced under pressure, the pressure (6 psi.) coming from the plant blower system. The sulphur dioxide and finely divided air are separately introduced with air into wooden vats containing ferrous-sulphate solution. This produces ferric sulphate. Part of the oxidized ferric-sulphate solution is circulated through tanks containing scrap iron to form the ferrous-sulphate solution. This ferrous sulphate is diluted with make-up water to maintain constant iron strength.

A similar but larger autoxidation plant is being constructed to produce ferric sulphate coagulate at the new Phoenix water-filtration plant.

Use of ferric sulphate to dose the plant effluent to correct alkaline effects in desert soils has been tested at the Phoenix plant. Solutions from the autoxidation process acidify the effluent and under test conditions have promoted better plant growth when used to irrigate alkaline soils. Further research and agricultural testing is underway in the Salt River Valley.

Engine cooling water heats digester

The primary digester is maintained at a temperature of about 85 deg. F by a system that uses the cooling water from the dual-fuel engines to provide heat. Cooling water from the engines is circulated through a piping system to the digestion control house some 350 ft. away. Here an American Heat Reclaiming Corp. spiral-type exchanger is used to heat the sludge which circulates through the exchanger and then passes into the digester. If hot water produced by jacket cooling is insufficient, gas from the engine can be used. If more hot water is produced than needed to warm the digesters, the engines can be cooled by evaporative coolers.

This work is under the direction of R. Gail Baker, city engineer, and Dario Travaini, plant superintendent. Design and supervision of construction was done by Headman, Ferguson and Carollo, consulting engineers. Resident engineer on the construction work was H. N. Carey. The autoxidation process was developed by H. E. Keyes, chemical engineer of Phoenix.

Zinc Anode Protects Steel Against Corrosion in Soil

In a study of electrical protection against underground corrosion, steel specimens were found to be protected for three to six years by connecting zinc cylinders to them.

I. A. Denison and Melvin Romanoff report (Behavior of Experimental Zinc-Steel Couples Underground, *Journal of Research*, National Bureau of Standards 40, 301 RP (1948) 1876), that the current required to prevent the corrosion of steel electrolytically was nearly equal to the current associated with normal corrosion and hence could be taken as a measure of the corrosion rate in the soils studied. From this it would appear that cathodic protection is—under ideal conditions—an efficient means of combating corrosion of steel, since all current is utilized in eliminating local corrosion circuits.

Corrosion in soil is often caused by differences in electric potential of local areas, which cause some areas to act as anodes (high potential) and some as cathodes (lower potential). The latter are not subject to corrosion, as are the former, because current flows toward, rather than from, cathodic areas. If sufficient current is made to flow from an external source toward the corroding surface, the potential differences between the local anodic and cathodic areas are eliminated and with them the cause of corrosion. This principle, the basis of cathodic protection, has effectively protected underground pipes.

If electricity is available, a cathodic unit can be economically installed. However, long pipelines often traverse corrosive soils so remote from power that cost of cathodic protection may be great. In such cases, energy can be provided by galvanic corrosion of electronegative metals—zinc, magnesium, or aluminum—attached to the pipeline at suitable intervals.

To investigate behavior of zinc anodes for cathodic protection, the National Bureau of Standards in 1941 ran field tests in cooperation with pipeline companies, in which zinc-steel couples were tested at eight test sites.

In six tested soils it was found that protection was satisfactory. A zinc-steel area ratio of 1:20 was sufficient at three sites and a ratio of 1:10 at the other three. But at the two sites, high resistivity and alkalinity of the soil reduced current output of zinc anodes to such an extent that cathodic protection was not obtained. It is probable, that these conditions could be counteracted by surrounding the zinc anodes with a salt such as calcium sulfate.

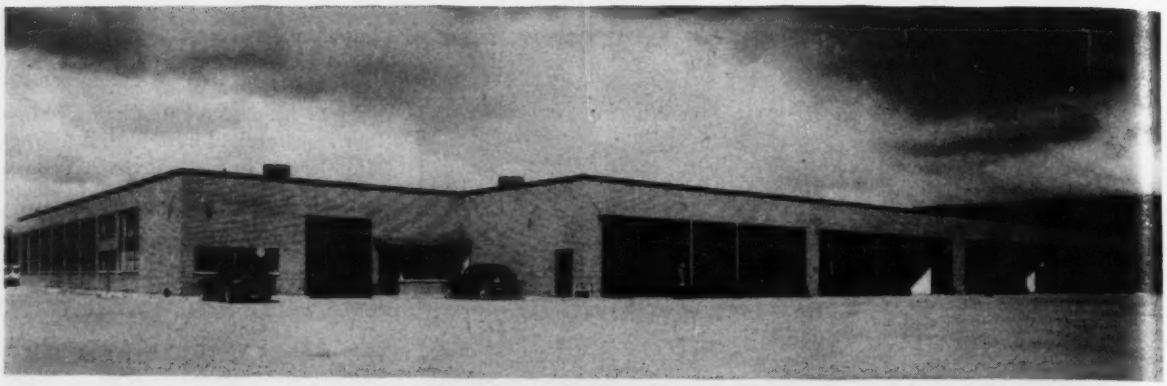


FIG. 1. BEHIND THE PLAIN BRICK EXTERIOR of the Detroit terminal are new ideas on equipment and layout.

Super-Service Garage for Buses

Clarence E. Day
Senior Partner,
Harley, Ellington & Day, Inc.
Detroit, Mich.

IN DESIGNING Detroit's $2,500,000 Samuel T. Gilbert Terminal, safe, speedy servicing of huge urban buses was the principal objective. Use was made of automatic equipment, radiant heating, and fluorescent lighting to make operations as efficient as economically feasible.

For example:

The garage contains an automatic washer that can clean a bus in 2 min.

In the gas house, a coach can be refueled in 6 min. with 125 gal. of gasoline. The drainage system there is unique in that spilled gasoline is prevented from entering the sewer and may be salvaged. Drainage is conducted to a collector tank, which incorporates a float that sinks in gasoline. Thus, a change of fluids moves the float and operates valves to permit water, but not gasoline, to pass into the sewer. At intervals, gasoline must be pumped out of the collector tank.

Water used to operate the gasoline storage tanks also is disposed of through this tank. There are three 50,000-gal. underground storage tanks and a 20,000-gal. diesel oil tank outside the garage.

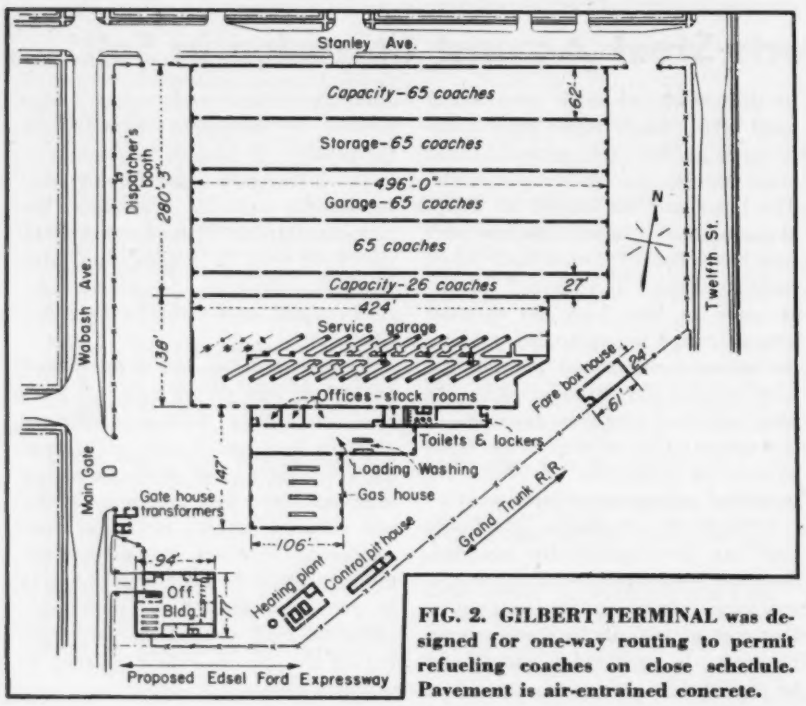


FIG. 2. GILBERT TERMINAL was designed for one-way routing to permit refueling coaches on close schedule. Pavement is air-entrained concrete.

Precautions to prevent explosives

Electric wiring and lighting fixtures in the gas house and the 23 repair pits of the service depot are explosion proof, as are the equipment motor starters and float switch on the sump pump. Fan wheels in the blowers are aluminum, or other nonferrous material, to prevent sparking should a wheel come in contact with the fan housing. And iron is incorporated in the concrete floor of the gas house to ground it.

Pit lighting is synchronized with the ventilating system so that when lights are turned on in the pits, the ventilating fans start operating. This forces in fresh air, which exhausts the foul air from the sides of the pits and thus minimizes asphyxiation hazards. In addition, a tailpipe exhaust system is provided to discharge fumes directly through the roof.

The Samuel T. Gilbert Terminal is located almost in the geographical

heart of the area served by the Detroit Department of Street Railways. It will serve as an operating base for several of the transportation system's more heavily patronized coach lines. The 10-acre tract upon which the terminal was built is adjacent to the intersection of the Edsel B. Ford crosstown expressway and the John C. Lodge north-south expressway, both of which are under construction.

Providing 247,500 sq. ft. of floor space, the terminal consists of service and repair depots, an office building, fare-box house, heating plant, electrical substation and a garage that can accommodate 286 coaches (Fig. 2).

One-way routing through the building coordinates traffic so that operating coaches can pass through for refueling on a close schedule. The fare-box house is set up so that a driver can deposit a full box at one end, collect a new one and install it without slowing down from the terminal speed limit.

Structural features

Buildings are of masonry wall-bearing and steel frame construction. They are one-story high, except the terminal office, which is two stories. All are equipped with automatic sprinkler systems.

Exterior walls of the garage and terminal consist of cinder-block back-up with face brick exterior (Fig. 1). Roof slabs are 2½-in. thick cast-in-place gypsum topped with 20-year built-up tar and gravel roofing. Over the garage, gas house and wash rack, the roof rests on open-web steel joists. Over the 138-ft. wide service garage, which has one row of columns down the center, the roof is supported on heavy steel trusses and purlins, from which a vermiculite-plaster ceiling is suspended 18 ft. above the floor level. (Fig. 4).

Radiant heating is used in the terminal and garage. Hot water is passed through wrought iron pipes, laid on a bed of 8 in. of crushed stone and embedded in the sand fill under the 8-in. concrete floor slab (Fig. 3). The water is heated by steam, with temperatures controlled to keep the heat output at a minimum of 60 Btu. per sq. ft. For this purpose, the heating plant is equipped with two 200-hp. oil-burning boilers.

Main doors to the garage are two-leaf, steel and glass overhead-opening type, electrically operated. They are 13 ft. high and 12 or 22 ft. wide

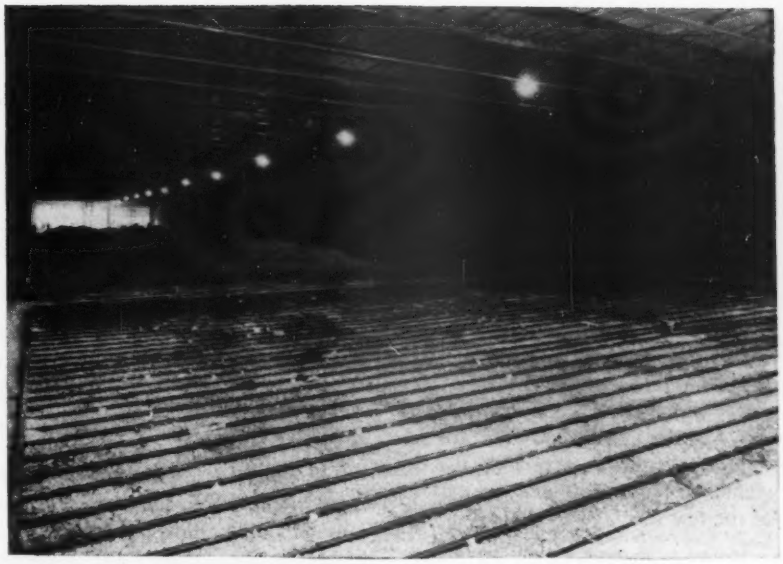


FIG. 3. RADIANT HEATING PIPES are embedded in sand fill under the floor.

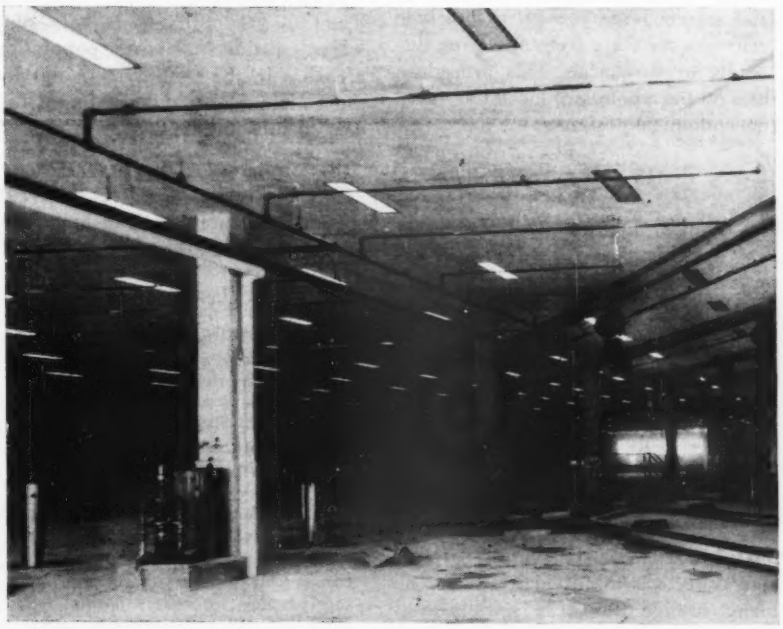


FIG. 4. SPARK-PROOF CONCRETE FLOORS and a suspended vermiculite plaster ceiling are two special features. Lighting is flush-type fluorescent.

Details of terminal office

The office building, which has facilities capable of accommodating 600 drivers, has painted cinder-block walls, a concrete roof slab insulated with 4-in. rock-wall batts, aluminum and steel sash, aluminum exterior doors and trim, movable metal partitions, concrete floors with asphalt-tile finish, and acoustical suspended ceilings. Lighting is flush fluorescent in the second-floor assembly and recreation rooms.

Gilbert terminal was constructed under the general supervision of Fred C. Taylor, chief engineer of Detroit's Dept. of Street Railways, and L. H. Waldo, project administrator for the firm of Harley, Ellington & Day, Inc., architects and engineers. The contractor was O. W. Burke Co. of Detroit.

A Critical Appraisal of

Sanitary-Sewer Design Formulas

Richard Bennett
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Phoenix, Ariz.

WIDE—and sometimes wild—variations in design methods for estimating sanitary flow and determining sewer sizes are the rule in present-day practice. Published data are seldom in a form that permits the designer to appreciate the limitations of the few formulas available.

In the past most sewers have been designed on a haphazard basis. The designer's primary aim has been to size sewers large enough to preclude criticism resulting from operation difficulty or surcharge. This procedure has, on the whole, produced too many uneconomical designs.

Few design curves are available

Technical literature contains very few design-curves for sewer-size determination. *Design of Sewers* (American Sewerage Practice, vol. I, 1928, McGraw-Hill Book Co., New York, N. Y.)—the outstanding text in use today—contains only one design curve (Fig. 1), and that was worked up exclusively for Louisville, Ky. No doubt the curve is perfect for Louisville but its indiscriminate application elsewhere is to be condemned.

One reason for the scarcity of design criteria is the difficulty of measuring sewage flow. If sewage-flow measurements for specific localities could be collected, studied in regard to individual differences, correlated and made available to sanitary engineers, a serious design-deficiency would be remedied.

Statisticians serving particular fields attempt to predict future trends by carefully analyzing past and present occurrences. But engineers have made few attempts to gather operating data on sanitary-sewer systems. If they know little or nothing about performance of an existing system, then design of extensions or improvements will be largely "guessed out", certainly not determined on the basis of scientific measurements.

A recent manual on sanitary sewers (*Clay Pipe Engineering Manual*, Clay Products Association, 1946) states, "it is common practice to base designs upon 100 gallons per capita average daily flow. This estimate should be used when more accurate data are unavailable and then with full understanding of its limitations. The 100-gal. estimate is safe only when considering large population areas". In the southwestern part of the United States, I have found few data to substantiate this statement.

In an article on sewer design (*ENR*, Sept. 23, 1939, vol. p. 419) engineering data for Cranston, R. I. was given as follows:

Average water consumption—95 gal. per capita per day.
Maximum daily rate—175 percent of average.
Maximum hourly rate—140 percent of maximum daily rate.
Sewage flow—70 percent of water consumption rate.
Maximum sewage rate—285 gal. per cap. per day for areas of 5 acres or less, and decreasing to 245 gal. per cap. per day for areas of 100 acres or more.
Commercial sewage—25,000 gal. per acre per day, for sewers flowing full.

In comparison sewer-design data for Phoenix, Ariz. is:

Average water consumption—330 gal. per cap. per day.
Maximum daily rate—121 percent of average flow.
Maximum hourly rate—137 percent of maximum daily rate.
Sewage flow—43 percent of water consumption rate.
Average sewage flow—142 gal. per day per capita.
Maximum sewage flow—168 gal. per day per capita.
Maximum hourly sewage flow—182 gal. per day per capita.
Ratio of maximum hourly to average daily flow—1.28 percent.

The accompanying data is cited to illustrate how dangerous it is to design sanitary sewers by a curve derived for another city. Basic data in these two cases bear little relationship to each other.

Straight-line design formulas

Many designers use straight-line design formulas of which the following are examples:

(A) Maximum rate of flow for sewer flowing full—20,000 gal. per acre per day. Reserve capacity is included.

(B) Maximum rate of flow (a) for sewers 24-in. or smaller flowing half full—200 gal. per capita; (b) for sewers larger than 24 in. —12 in. or more space between water surface and top of pipe. (Now recommended by a national organization).

(C) With sewer (all sizes) flowing half full—135 gal. per capita delivered to sewer in 1,000 min. for sewers flowing full—388.8 gal. per capita per day. This formula was advocated a few years ago by Clay Products Association, and apparently was derived from the older formula: Average flow—100 gal. per cap. per day; maximum flow double the average with sewer flowing half full; total flow, sewer flowing full—400 gal. per cap. per day.

(D) The formula derived for use at Louisville, Ky. and based upon many tests for sewers flowing full, is: Up to 10 acres—21,900 gal. per acre. From 10 to 1,000 acres to decrease in a straight line on log-log chart from 21,900 to 9,960 gal. per acre. For more than 1,000 acres—9,960 gal. per acre.

(E) A municipal sewerage division in California uses this formula: For residential areas up to and including 15 in. pipe when flowing half full and three-quarters full for larger pipe—0.004 c.f.s. per acre.

Another formula used by many engineers and designers in the past are:

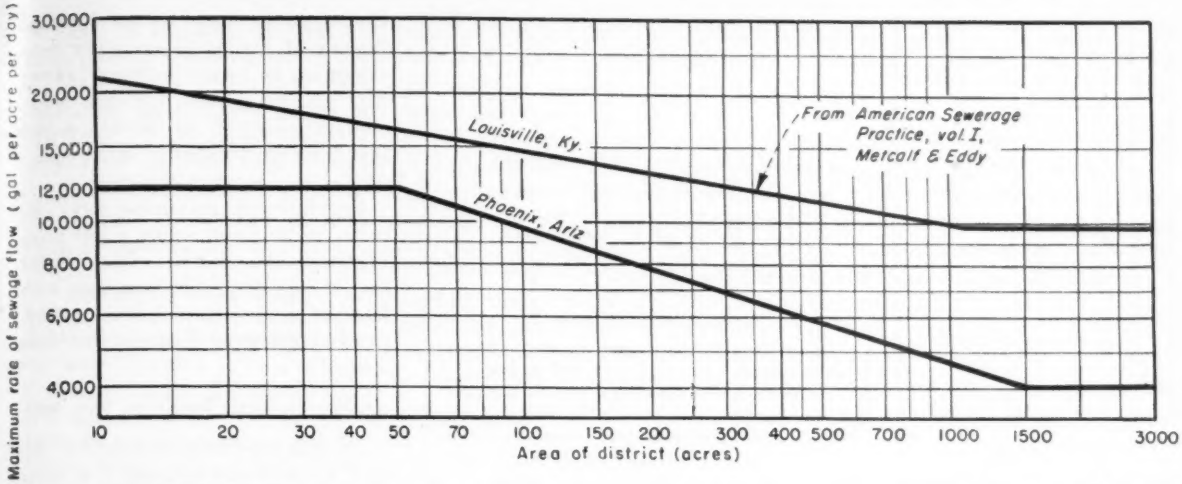


FIG. 1. SANITARY-SEWAGE flows used for design purposes in Louisville, Ky., and Phoenix, Ariz. vary widely when compared on an area basis.

(A) Determine average rate of flow from area.

(B) Double (A) for maximum rate of flow.

(C) Lateral sewers to flow one-half full at maximum rate of flow.

(D) Main sewers to flow two-thirds full at maximum rate of flow.

(E) Outfall sewers to flow 0.8 full at maximum rate of flow.

This formula has some merit but determining item (A) for each area usually leaves the engineer dangling to such extent that his design is little better than a shrewd guess. If item (A) is properly determined, the result closely resembles the log-log type of curve, but designer must judge what is a lateral, a main and an outfall sewer. Who knows that answer for all sewerage systems? A derived formula as given for Louisville or Phoenix (Fig. 1) will obviate this trouble.

Straight-line formulas usually select sewers too small for small areas and too large for the outfall sewers serving large areas.

Sewage flow measured in Phoenix

A sanitary-sewerage survey was made for Phoenix, Ariz. Part of the work required a complete flow study of the entire system. The report included charts showing weekly flow at over forty points in the system. This study was essential as almost no data was available on which a design curve for sewer sizes could be derived.

From the weekly flow charts, all maximum instant flows were compiled and extended to conform to the maximum population density per acre predicted in the report. Maximum predicted instant flows for various sizes and types of districts were plotted on co-ordinate paper (Fig. 2) from which the maximum rate of flow (sewers flowing full) curve was derived. This curve (Fig. 1) was then plotted on log-log paper—a much better form for design purposes.

To meet all instant flows, the Phoenix design curve is based on sewers flowing full and includes an ample safety factor. For all districts except high office buildings, large hotels, and industrial districts which require special attention design data is:

Up to 50 acres—12,000 gal per acre.
From 50 to 1,500 acres to decrease in a straight line on log-log chart from 12,000 to 4,000 gal. per acre.
For more than 1,500 acres—4,000 gal. per acre.

In using the Phoenix curve as well as studying the derivation, it is of interest to note that the curve deviates from practice advocated in most standard texts on design of sanitary sewers. They generally advise the student to determine and analyze average rate of flow for each sewer, multiply average rate by two to obtain maximum rate of flow, and then provide a factor of safety by multiplying the maximum flow again by two (full capacity of the sewer).

For Phoenix such a design factor has little basis for adoption. It gives a factor far too low for small areas and much too large for trunk and outfall sewers. Using actual flow conditions, small and large sewers would have about 45 and 135 percent required capacity, respectively.

For Phoenix as a whole the ratio of maximum to average flow is 1.28. For one small area—less than 45 acres in extent—ratio of maximum to average flow is 2.74—a wide variation from a factor of two.

The Phoenix report estimates that ultimate average population density will be 15 persons per acre. From the curve in Fig. 1, maximum sewage flows (pipe full) of 800 gal. per capita per day for areas of less than 50 acres and 270 gal. per capita per day for areas greater than 1,500 acres are obtained. This rule gives sewer sizes quite different than would be found by use of straight-line formulas cited above.

Another equally important factor is that most texts recommend that sanitary sewers be designed on the basis of population served. The study reveals the population-served factor has little or no significance in the design of Phoenix sewers. Consider the two actual cases in Phoenix:

District "A"

Area 48.80 acres
Population density—26.7 per acre
Maximum flow—45 gal. per cap. per day
Small amount commercial and industrial sewage.

District "B"

Area 20 acres
Population—7.32 per acre
Maximum flow—540 gal. per cap. per day
Residential sewage only.
(See points A, B, C in Fig. 2 corrected to population of 15 per acre).

Wide variation of maximum flow

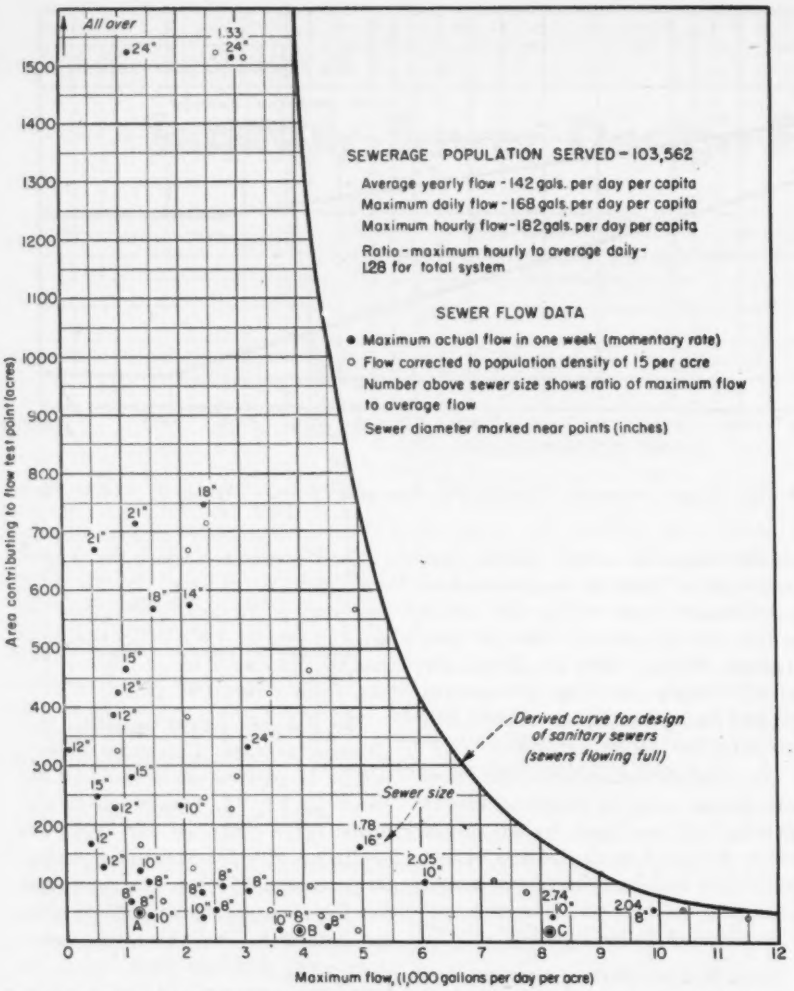

SEWERAGE POPULATION SERVED - 103,562
Average yearly flow - 142 gals. per day per capita
Maximum daily flow - 168 gals. per day per capita
Maximum hourly flow - 182 gals. per day per capita
Ratio - maximum hourly to average daily - 1.28 for total system
SEWER FLOW DATA
Maximum actual flow in one week (momentary rate)
Flow corrected to population density of 15 per acre
Number above sewer size shows ratio of maximum flow to average flow
Sewer diameter marked near points (inches)
Derived curve for design of sanitary sewers (sewers flowing full)
Sewer size
All over
Area contributing to flow test point (acres)
Maximum flow, (1,000 gallons per day per acre)

FIG. 2. THE MAXIMUM RATE-OF-FLOW CURVE for design of sanitary sewers in Phoenix, Ariz. was derived from actual flow measurements taken at 40 points in the sewerage system over a period of several months.

from the two districts may be attributed to per capita wealth. District "A" is a low-income district; District "B" is one of the wealthiest districts in the city. Groundwater infiltration is absent in both cases.

The Phoenix curve gives a ratio of 3:1 between maximum and average flows for areas less than 50 acres. Data from the recent sewage-flow investigation proves that this ratio is justified.

The derived-curve formula provides for unusual development of small areas such as increased population density, limited commercial or industrial use — factors which straight-line formulas usually do not evaluate accurately.

Sewerage designers often use empirical methods not derived from sound engineering data applicable to local conditions. If the straight-line formula is correct for small areas, then large sewers are designed too big. If, on the other hand, the formula is accurate for large sewers, then small sewers will be greatly underdesigned.

Most designers estimate average rates of sewage flow and multiply the average rate by arbitrary factors to determine maximum flow as well as excess capacity for a factor of safety. This method would, in general, prove satisfactory if based and derived entirely upon local conditions. Too often empirical curves used by one city are used by another municipality without regard to applicability, so that the sewers are either too large or too small.

Where and when maximum sewage flows will occur cannot be predicted. Investigations made by the National Bureau of Standards on water consumption in large buildings shows that maximum flow will not occur simultaneously in all laterals, a fact that has been verified by many measurements in various localities.

For Phoenix, maximum flows decrease to the point where 1,500 acres is served. At Louisville, allowance for rate of maximum flow decreases with increase in area up to 1,000 acres beyond which a uniform rate of flow is used.

Design formulas based on flow data

To gather reliable flow data to design an accurate formula for local conditions requires a considerable number of sewer gagings. The number of gagings must be sufficient to show flow conditions from the total sewered area and various 10-acre types with a complete intermediate range. From such data a curve may be derived to show required pipe sizes for various types of service—such as residential, commercial, industrial, hotels and schools.

It is common practice to design sanitary sewers with considerable reserve capacity. If reserve capacity is to be consistent in both small and large sewers, then a variable-flow formula must be utilized.

Sewage flows from commercial areas may range from 4,000 to 40,000 gal. per acre per day. Flow from industrial areas may range from 1,000 to as much as a half million gallons per acre per day. Only local gagings will determine the proper factor to use in computations.

Design data for a federal-housing project is given as 600 gals. per day per dwelling—sewers flowing half full or 1,200 gals. per day per dwelling, sewers flowing full (ENR vol. p. 775, May 1942). Some federal-housing units in Phoenix have about 18 living units per acre which by this formula should produce a maximum flow of about 21,600 gal. per acre per day. Actual flows are about one-third of this amount. This formula would not fit many conditions. It does not provide for differences in local conditions or variations in sewage flow according to project size.

The *Clay Pipe Engineering Manual* also states, "Experience shows that the maximum flow rate is seldom more than double the average daily

flow rate." It has been my good fortune to check a number of sewer systems but I have seen few data which would verify the foregoing statement. Usually the ratio of maximum to average flow for an entire city is much less than the two to one. Flow in small areas usually results in a much greater proportion.

Factors for sewer design

In designing sewers, several factors must be evaluated:

1. General economic nature of the area to be served.
2. Number of people in the area or acreage density (a minor factor under Phoenix conditions).
3. Ratio of maximum to average flows decrease with increase in size of contributing area.
4. After a design curve has been derived to fit local residential conditions, special conditions of schools, commercial, industrial areas, and ground water infiltration must be allowed for as extra flow.
5. There is some evidence that type of zoning regulations affects maximum sewage flows but the recent Phoenix study seemed to offer little confirmation in this respect.

It has often been said, and is largely true, that sanitary-sewer designs cannot be made with extreme accuracy due to many unknown variables, but the Phoenix study indicates there is room for much improvement in present-day practices.

I do not contend that the straight-line sewage-flow formulas used today are wrong for cities where they originate and for which they were intended. But I believe that indiscriminate adoption and use of these formulas without checking applicability to local conditions, derivation or other special factors, is little short of ignorance of the first order. Yet I have seen that very thing done repeatedly.

We should eliminate the 'factor of ignorance' which so many today use to the extent of 100 percent and reduce the factor of safety to a reasonable margin dictated by sound engineering practice. We should not use 'fear' ratios for what might occur.

My experience has been that in sanitary-sewer design practice the straight-line per capita design formula has little merit to recommend its further use. Perhaps this type of formula satisfies flow conditions perfectly for some cities, but I have yet to see a complete set of flow measurements for a complete sewerage system whose analysis would yield such a derivation

Notes on Legal Decisions

Summaries of decisions relating to construction prepared by I. Vernon Werbin, counselor at law and engineer, New York

Determination of Disputes by the Engineer

Most construction contracts state that disputes arising out of the work will be referred to the architect or engineer and that his determinations will be binding and conclusive on parties to the contract. Under such a provision the general rule is that the determination of the architect or engineer is conclusive and binding on the parties unless it can be impeached for fraud, bad faith or palpable mistake appearing upon the face of the certificate[1].

The determination is not binding when it is based upon an erroneous interpretation of the contract. Where there is no basis for the determination or where it is evidently erroneous, it is the equivalent to a finding of bad faith on the part of the engineer.

A determination made under such circumstances is not binding on the contractor[2].

The very extent of the power and conclusiveness of the engineer's or architect's determination raises a corresponding duty that his judgment should not be exercised capriciously or fraudulently, but reasonably, with due regard to the rights of all contracting parties[3].

The mere fact that an engineer is in the employ of one of the parties and acts for him will not nullify his work as an umpire, if his final conclusions appear to be the result of the exercise of honest judgment. But where a person acting in that capacity deliberately and arbitrarily rules in favor of the company that employs him and against the contractor, it cannot be said that he acted honestly and in good faith. A determination made under such circumstances is not binding on the parties. It is not necessary to show personal animosity or calculated bias, prejudice or actual dishonesty. Good faith and impartiality, or gross error and implied bad faith, are all to be considered by the court in a legal sense. A decision or finding may be held to be arbitrary when important facts, conditions and express contract provisions should obviously have been considered but were not[5].

(1) Daniels Co. v. City of New York, 196 App.Div. 856.
(2) Smith Contracting Co. v. City of New York, 240 N.Y. 491.
(3) Phoenix Bridge Co. v. United States, 85 Ct.Cls. 603, 629; Ripley v. United States, 223 U.S. 695, 701.
(4) Southern New England R. Corporation v. Marsch, 45 F.(2d) 766.
(5) Needles, etc. v. United States, 101 Ct. Cls. 535.

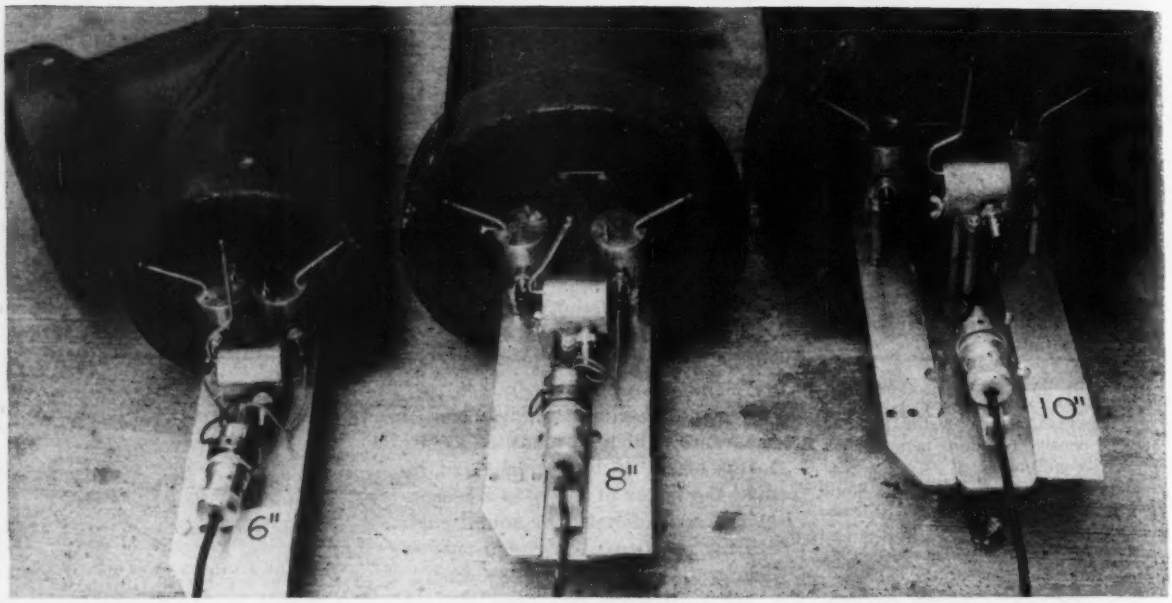
Varying The Amount of Work

Construction contracts usually provide that the estimated quantities of work are approximate only. In the absence of fraud, bad faith, conscious misrepresentation, or where the variance in the amount results from an honest error or miscalculation, there is no liability for damages from a difference between the estimated and actual quantities of work done[1].

Contract provisions usually give a party the right to make additions to, or deductions from the amount of work to be done. This does not give the right, under the guise of necessity, to alter or destroy the essential identity of the thing contracted for[2]. The change or alteration in the work may be so substantial as to constitute a breach of the contract [3].

A provision "to omit any portion of the work without constituting grounds for any claim by the contractor for payment or allowance for damages or extra service other than is provided for under the classified Items of the Schedule of Unit Prices", was held "in the clearest language" to give the power to omit work without incurring liability[4].

(1) Manstin Engineering Corp. v. State of New York, 288 N.Y. 657, 42 N.E. (2d) 747.
(2) Dumbar & Sullivan Dredging Co. v. State, 20 N.Y.S. (2d) 127, 259 App.Div. 440.
(3) McMaster v. State of New York, 108 N.Y. 542.
(4) Del Balso Const. Corp. v. City of New York, 278 N.Y. 154, 15 N.E. (2d) 559.



HUNTING LOST CONNECTIONS by excavating was slow and costly, so an engineer invented this . . .

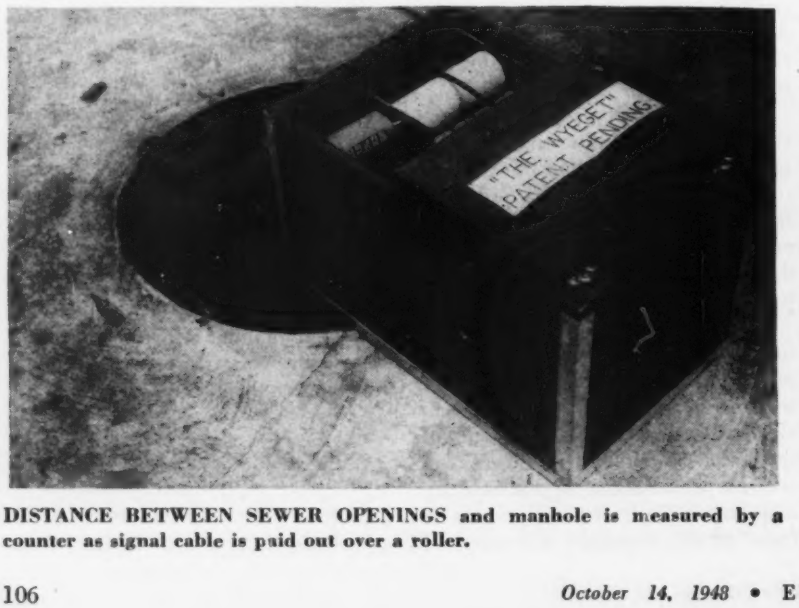
Device to Speed Sewer Surveys

UNCHARTERED OPENINGS in sewers can be quickly located with an instrument devised by Alex W. Ely, Madison, Wis. engineering consultant. Pulled from manhole to manhole through the pipes, the device which indicates the position of all wyes, crosses and tees, has chartered openings at the rate of 10 ft. per min. It can be used to check sewers varying from 6 to 21 inches in diameter.

Named the "Wyeget", the instrument has three adjustable spring-loaded feelers that make contact with the sides and top of the pipe. When a feeler encounters an opening as the device is pulled upstream along the pipe bottom, it swings into the gap. The swinging motion turns a cam which makes electrical contact to send a signal through a taut trailing cable to an indicator box mounted over the rear manhole.

In the indicator one of three audible signals tells the position of the opening in the pipe. A counter, which reads to one-tenth foot, measures the distance from opening to manhole by indicating the length of signal cable paid out.

The three feelers and associated springs, cams and switches are mounted on a plate that stays horizontal in the pipe. The plate is adjustable for 6, 8 or 10-in. sewers, and a dual set of plates gives the instrument a range up to 21 inches. Different length legs for the feeler assemblies put them at the correct height to chart openings in the various size pipes.



DISTANCE BETWEEN SEWER OPENINGS and manhole is measured by a counter as signal cable is paid out over a roller.

Powered by batteries

Signaling current is supplied by two series-connected 6-volt A batteries whose low voltage permits the Wyeget to operate even in a sewer flowing full. The signal cable passes over a friction roller connected to a counter, which it turns in unreeling to indicate distance to the opening. A lightweight jack in the manhole below the recorder controls cable travel.

The Wyeget is pulled through the pipe by any available equipment such as sewer rods, flexible cable or 1¼ x ¼-in. elm strips, although a light tape is preferred. The operation goes quickly. In a recent study at Milwaukee, Wis. 300 ft. of pipe was surveyed in only 30 minutes.

How Underground Factories Performed

PRESENT INDICATIONS are that plans for placing industries in the United States underground are being abandoned as not economically feasible. Before this decision was reached, however, many studies were made of subterranean plants both at home and abroad.

Fear that a surprise bomb attack by an enemy air force might destroy essential industries had prompted the Army to consider putting certain of these facilities underground (*ENR* Feb. 27, 1947, vol. p. 347 and May 29, 1947, vol. p. 863). Precedent for such a step is found in Germany, Japan, Italy, Czechoslavakia and Sweden.

Since the experience of these countries may be helpful in planning similar subterranean structures, a group of McGraw-Hill editors compiled a summary of available information, and the portion pertaining to design and construction is presented here. Sources were the official reports of the Strategic Bombing Survey, Underground and Dispersal Plants in Greater Germany (Oil division) and Underground Production of Japanese Aircraft (Aircraft division), as well as original reports from correspondents abroad.

Rushed contruction proves bad

With few exceptions, subterranean plants in Germany, Japan and Italy were not planned beforehand. In most cases the factories were hurriedly located in existing caves, mines, quarries or tunnels, these being enlarged or altered as necessary to fit them for this new service. Construction was hampered by shortages of manpower, materials and equipment, so that some desirable features, such as air conditioning, often had to be omitted.

Many German and Japanese plants were subject to excessive dampness, which caused rapid corrosion and deterioration of equipment, as well as discomfort and illness. Japanese underground plants in particular were notoriously lacking in features that promote worker efficiency, comfort and health.

In general, the most desirable sites were found to be in the sides of a hill or mountain. Such locations were drier and less likely to give trouble from ground water. Side-hill locations also made installation of sewer systems easier, afforded more adequate ventilation and usually provided better entrances and exits. In contrast, underground plants located in the foothills or valleys usually were wet. The Germans—and presumably the Japanese—experienced other difficulties, such as the need for gas-proofing, dust control and noise absorption. Thus, the desirability of planning and building underground plants before the onset of an emergency is obvious.

Destruction of supply lines fatal

The Germans did not have an opportunity to place the full range of supporting activities underground, such as power plants and transportation systems. Electric power usually was furnished by existing local facilities and transformed to the desired voltage by subterranean transformer stations. Three underground generating stations were said to have been a part of the grid near Clausthal which supplied power to mines and towns in the area, but this was the exception.

Evidence of the paralyzing effects of bombing power installations rather than the production area itself was demonstrated in the attacks on a Krupp plant. Bombing the target itself succeeded in curtailing production only 30 percent. However, destruction of power-generating and distributing facilities resulted in virtually complete shutdown of plant operations. On the basis of German experience, it can be concluded that if surface transportation is blocked, delivery of raw materials prevented or electric power supply disrupted, production facilities become inoperative.

The desirability of putting transformers underground was shown by German surveys of bomb damage to electrical power-grids. Whereas transmission lines usually could be restored to service within a short time, transformers were quite vulnerable to the blasts and shocks of near misses as well as direct hits, and repairs were not easily or quickly made.

German experience also shows the need for ample storage space in underground plants for raw materials and products. It is recommended that such storage facilities should be sufficient to enable a plant to operate for at least two weeks without delivery or removal of materials. This would provide some degree of insurance against production delays due to the interruption of surface transportation.

Subterranean factory construction in Germany was initiated on a large scale in 1944. In the last months of that year, this work alone accounted for about 17 percent of total construction and 40 percent of industrial construction. By November, about 16,000,000 sq.ft. of underground floor area was in use or awaiting installation of machinery for armament and component industries; an additional small amount of completed space had been abandoned before the advancing Allied forces. Other principal occupants of underground space were the synthetic oil, airframe, motor, machinery, and electrical equipment industries.

German practice cited

A plan of one large German subterranean factory, which was excavated entirely for the purpose, is shown in Fig. 2. It was a Junkers plant, cut into a hill with an average ridge height about 1,000 ft. above sea level. The shape of the hill was such that three sides were accessible for mine entrances at the base of the surrounding valley. These entrances were located about 15 to 25 ft. above the original ground level of the valley to utilize excavated material for fill in swamps.

Mining operations commenced simultaneously on the northern, eastern and southern slopes. On the north, six mine entrances were first opened (A, B, C, D, E and F in Fig. 2), and later four more were added. Tunnels A and B were about 6,000 ft. long, and several other main tunnels averaged 3,000 ft. in length. The width was adequate for double-track rail-

Signal Corps—U. S. Army photo

FIG 1. IN THE SWEDISH ENGINE FACTORY (top) at Eskilstuna, working conditions are reported to be excellent, whereas in the Japanese plant (bottom) near Osaka, dampness caused trouble.

way lines and runways for five-ton cranes. Cross-tunnels, which were used for production, were spaced horizontally 66 ft. apart in one direction and at least 190 ft. in the other.

Since geological tests had indicated that the tunnels need not be lined, consideration was given to selection of a shape to provide safety against collapse. Experience apparently indicating that arched roofs are far from ideal, the main tunnels were made rectangular, 41 ft. wide by 23 ft. high, with tops almost flat. The cross-tunnels, which also were 41 ft. wide, were vaulted, however, with a height of 23 ft. at the crown, and gave trouble on several occasions when large sections of stone gave way.

Some idea of the amount of excavation involved in this project may be obtained from the fact that about 6,500,000 cu.yd. of rock were handled at the northern entrances alone. With respect to ventilation, it might be noted that in case of attack, the tunnels could be made air-tight, necessitating use of a forced-draft system capable of supplying fresh air for 10,000 people. Long hours of work in this plant proved tiresome, and adjustment of the moisture content of the air was necessary to prevent throat and head ailments.

Sweden furnishes good example

In contrast to the experience of Germany and Japan, those of Sweden have been satisfactory (*ENR* Dec. 5, 1946, vol. p. 754). Although Sweden was not in World War II as a belligerent, it was geographically in a dangerous position and prudence dictated that certain defense measures be taken. One of these involved the decision to undertake airplane-engine production below ground.

A suitable hillock of solid rock was discovered in an alluvial plain within two miles of an existing surface plant. Transportation facilities, except those for workers, were of comparatively little importance in selecting the site, since airplane engines and the raw materials are easily carried by truck, and highways could readily be built. Railroad lines run in all directions in the neighborhood also, and in the unlikely event of all these being put out of action, water transport close by could be used.

The factory was cut out of the rock, with the general floor level about that of the surrounding country. It consists mainly of parallel bays, 50 ft. wide by about 400 ft. long, connected by transverse passageways. No roof or wall shoring is required.

The amount of rock cover considered necessary was a depth overhead equal to the width of the tunnel. However, development of larger bombs might necessitate revising the safety margin.

Swedish plant is air conditioned

There was no need to waterproof these rock tunnels, and any moisture that seeps through is carried off by conditioned air, which is kept slightly drier than normal. The main shops are inclosed in beaver board, which reportedly dampens noise effectively. The space between the beaver board and the rock is used as the return passage for exhaust air.

Cooling, rather than heating, is necessary most of the year. In departments where there is exceptional heat, such as the hardening room, air is cooled by a local system. Special arrangements likewise are made for

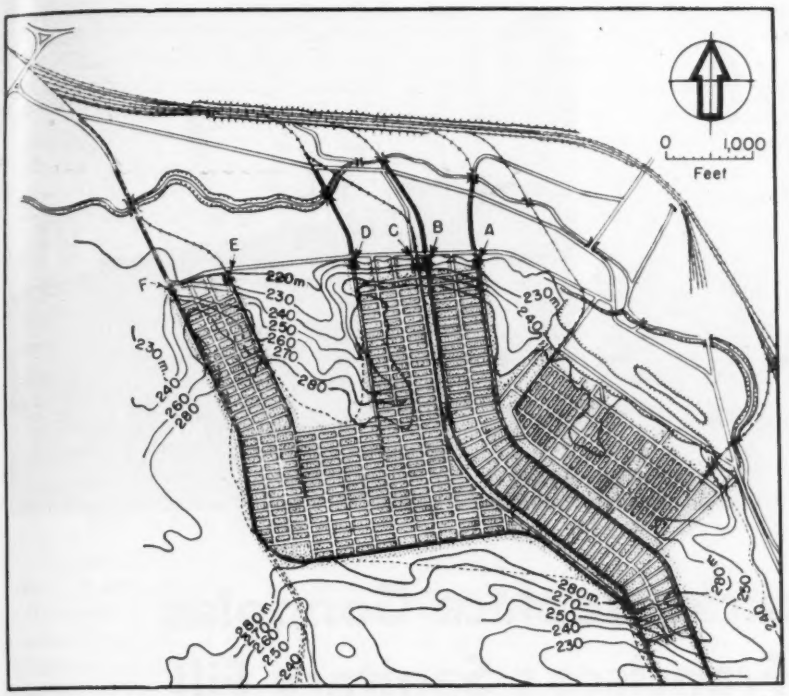


FIG. 2. PLAN of underground German factory. Entrances are on the north, east and south, at the base of a 250-ft. high hill.

confining dust to the place of origin. A particularly important advantage of the closed air-conditioning system is that humidity can be kept so low that nothing rusts.

Power is obtained from the national utility network. A reserve battery lighting system provides illumination in the event of power failure.

The plant has several emergency exits, including the natural exits provided by the engine-testing shafts. Doors are gas-tight and double, with an air lock between. Special power-driven air-conditioning apparatus can take care of poison gas, and hand-driven pumps are available in the event of a power breakdown. Lead baffles in the shafts and entrances would provide protection against radio-active particles.

Lockers and washing facilities are provided in a building at the entrance to the plant. The only sanitary arrangements underground are toilets. Since the floors are at ground level, the slight fall obtainable allows for natural disposal of sewage, which is not treated in any way. (At another plant, situated below ground level, sewage is simply pumped out.) Water is taken from both the water supply of a nearby city and a deep well.

Workers say they like the clean, warm atmosphere of the plant, particularly during the long, dark winter. No special measures have been necessary for keeping up morale. Such aids as sun-lamp treatments or special rest periods have not been found necessary. Productivity is at least as high as, if not higher than, that at the company's surface plant. Employee turnover has been no greater than in ordinary factories, with less than one percent leaving because the shop is underground.

Metalworking industries of the lighter, cleaner type obviously are particularly suited to underground operation. No Swedish industrialist has shown any sign, however, of being ready to go underground in peacetime. Those who were forced to do so during the war were simply pleasantly surprised to find out how painless it was, both to the budget and to their workers.

Problems still to be solved

Despite this background of experience with subterranean factories abroad, many questions still remain unanswered. For example, what specific industries can be adapted to underground operations and how can their owners be induced to go below in peacetime? How should workers be housed? How much cover is needed for protection against bombs?

The staggering cost of burying extensive production facilities evidently indicates that other defense methods may be more economical. It might be cheaper, for instance, to maintain an air force capable of intercepting and defeating attackers before they reach the American continent.

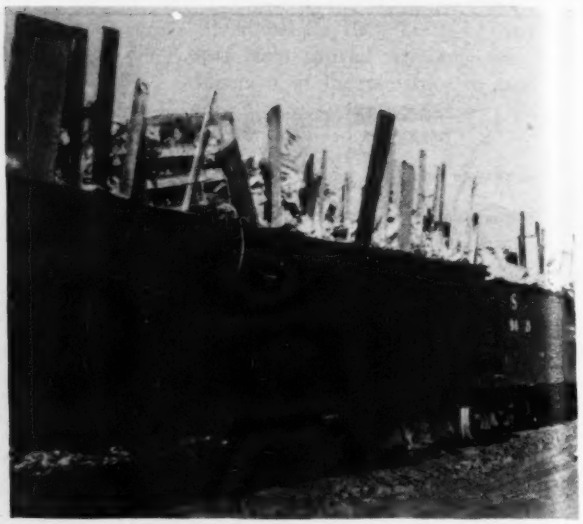
Recently, Gen. Jacob L. Devers, commander of the Army Ground Forces, disclosed that dispersion of factories and industrial stockpiles appears to be a more favorable solution. Subassembly plants may be scattered so that if one unit is bombed the entire plant need not be rebuilt to resume production. It is believed that use of atomic bombs against small plants would be too costly. However, it still may be feasible to put the most essential factories below ground.

Also, there may be merit in a plan to utilize subterranean sites for more than one use. For example, tunnels could be built through hills or mountains for peacetime highway shortcuts and for wartime use as factories. Such use was, in fact, made of highway tunnels in both Italy and France.

Two-stage Treatment For Spent Pickle Liquor

The Sharon Steel Corporation at its Sharon, Pa. works is operating acid-neutralizing facilities for treatment of spent pickle liquor—the used acid resulting from cleaning of steel during manufacture. This treatment is being carried on to reduce stream pollution from wastes in furtherance of the Clean Streams drive of Pennsylvania's Sanitary Water Board.

The company is operating two-stage treatment—a new development for neutralizing spent acid wastes developed at the Mellon Institute by the American Iron & Steel Institute Fellowship. The first step in treating waste waters is effected by mixing finely pulverized limestone with spent pickle liquors in a mechanically operated mixing chamber. This is followed by further treatment of the partially neutralized wastes with high-grade quick lime. After treatment is completed, the slurry is drawn off to drainage pits from which it is removed in railroad cars to dumping grounds.



Motor Trucks Replace Gondolas On San Francisco's Sanitary Fill

AN ENTIRELY SUCCESSFUL changeover from railroad gondola cars to dump trucks has been made in deliveries to the sanitary fill where San Francisco's 800 tons per day of refuse (mixed garbage and rubbish) is dumped and covered.

After 10 months of experience with the motor trucks it can be said that delivery by this method, though involving increased length of truck haul, has numerous advantages on the fill over use of the railroad cars. Experience in organizing the new plan of operation, together with latest observations on this fill project as a whole were developed in an interview with L. P. Brassy, the contracting engineer who has had charge of this fill for more than 15 years, and his assistant Douglas D. Trewhitt, fill supervisor. (Of several previous reports on operation of this fill published in *Engineering News-Record*, the latest appeared in the issue of Jan. 8, 1948 P. 40.)

Chief reason for the change

Primary reason for the change from gondolas was refusal of the railroad company to continue this service. Maintenance and repair of steel cars subject to daily unloading by the heavy grab buckets became a determining factor as labor and material costs increased from year to year. Also San Francisco property owners near the loading ramp in San Francisco where the collectors' motor trucks delivered to gondolas, complained that despite greatest care this ramp was a nuisance by reason of spillage and the light waste, such as newspapers, etc., that winds inevitably blew into adjoining areas. Papers and light materials also littered the right-of-way along the tracks near the fill.

In addition to relief on these counts, the change has eliminated the 11-man ramp crew, and has brought other advantages, particularly in operation of the fill itself. It has greatly improved the effectiveness with which placement of the refuse can be controlled and the program as a whole is now in such a satisfactory state that it is planned to extend the operations. The present 100 acres of filled land, representing the product of a 15-year disposal operation, can be extended along the shore to the north, using fill from adjoining property purchased for this purpose by the Sanitary Fill Company. The amount of this cover material and the extent of nearby tidal lands are sufficient to permit of continuing the present general program of disposal for another 40 to 50 years.

During all the time that refuse was delivered to the fill in gondola cars, it was impracticable to extend the face of the fill more than 400 ft. away from the unloading track. This was about as far as it was possible to bulldoze the material. Now, with motor truck delivery, there is greatly increased flexibility. Trucks go directly to any desired dumping point and only a minimum bulldozing distance is involved. In any emergency the trucks can be rerouted, temporarily or for as long as may be desired, to a new delivery point.

The operation as a whole is simplified by elimination of the unloading cranes on the fill.

Gas fires reduced

One of the greatest advantages of motor truck delivery is the improvement in the gas fire situation. Since trucks have been in use the number of fires has decreased 50 percent and the difficulty of controlling them has dropped to 25 percent under what it was under the old program. Because of the flexibility with motor truck delivery the outer face of the fill can now be kept at the desired depth;

with the gondola delivery it was a practical necessity to work the outer face of the fill at a height of 20 to 25 ft., and this has now been cut in half to a usual depth of 12 to 15 ft.

With this lesser depth of the working face there is less sloughing and hence less exposure of heated materials within the fill that tend toward spontaneous combustion of the gases when air (oxygen) gets to them. Fires still do break out on the present fill but they are relatively small and are always easily controlled by one of the bulldozers or by the fire truck. The latter consists of a 1,300-gal. tank on a motor truck with a 5-hp gasoline engine driving a pump delivering through a 1½-in. hose.

More uniform settlement

Unlike the sloughing on the steep face of the old fill as placed when delivered in gondola cars, the outer slope of the fill now settles to a fairly uniform grade that averages about 4 percent. The rate of compaction in the fill remains much as it was before. A layer initially about 12 ft. thick will compact within a few days to about 8 ft. and within 2 or 3 years to 4 ft.

Ordinarily this is near the ultimate compaction. Settlement does go on through the years but it amounts to relatively little. Bench marks placed for the purpose and checked by the city's survey crews from time to time have shown the settlement to be rather erratic, varying on different parts of the fill for deposits of the same age.

Now that the maximum flexibility of operation has been attained and fire control has been brought to a minimum of cost and attention required, it has been possible to concentrate on efficiency in actual placement and cover of the refuse. When the most advantageous location and depth of fill have been decided upon, the next objective in efficient control is to keep to a minimum the area of fill that requires cover. This makes for uniformity of successive layers and economy in use of cover material.

The procedure now is to have the trucks dump their loads along an imaginary line marking the inner edge of the advancing fill. A length of about 150 ft. would be the usual allotment for one day. As each truck moves away from the dumped load, which is a pile amounting to some 18 to 25 cu. yd., a bulldozer moves in and shoves the refuse out to the face of the fill, usually 50 ft. away from the starting line at the end of a day's work.

In this travel to and from the face of the fill the bulldozer moves over and greatly aids in compacting the material below. In travel over freshly-placed refuse the bulldozer will sink the material a foot or more below average level of the adjoining surface.

Thus a normal day's work represents a fill roughly 50 x 150 ft. in area and ranging in depth from 0 to about 12 ft. at the outer edge. Usually, 500 to 700 cu. yd. of earth are used to cover this 7,500 sq. ft. area 12 to 24 in. deep. However, "earth" is a misnomer, since rooters and blasting are necessary to obtain cover material in the borrow areas. The cover material for a long time has included more rock than earth. The heavy rock is usually rolled to the outer edge of the fill where it is of some benefit as cover and affords protection against wave action at high tide.

As the day's filling operation advances it is carried out the full 50 ft. distance near the starting end of the 150 ft. dumping line and this narrow tongue is widened as the work continues. The dump trucks bringing cover material follow this same transverse direction of progress and build successive 50-ft. windrows of cover material to be spread later.

Spreading the cover material

Spreading the cover material follows the placement of refuse within an hour or two, or whenever the bulldozers have free time. By the time the last trucks dump for the day usually only about a half hour of work remains for one of the bulldozers to completely cover the day's deposit of refuse. Only one bulldozer works later than 2 p. m. after which time very few trucks dump.

The bulldozers are standard D-8 tractors equipped with special blades, 14 ft. 8 in. long ranging to a maximum height of 50 in. in the central section. These blades were 16 ft. long during all the period of gondola delivery. As their function was then always straight-line movement of piles of refuse, the 16 ft. blade was always satisfactory. Under the new regime, final placement of the refuse often makes it desirable to bulldoze a pile of material along a curved instead of a straight line. When bulldozer operators found the 16 ft. blade difficult to guide on curves, lengths of the blades were reduced to 15 ft. This has afforded notable improvement in control.

The rated capacities of the dump trucks used in gathering refuse is 16 to 22 cu. yd. However, it is usual for the trucks to bring in a tonnage 25 to 30 percent more than full loads made by haphazard dumping of individual garbage cans into the trucks. This effective loading is accomplished by a two-man crew that carefully sorts and places the contents of each can as it is loaded. Salvegable materials are set aside in suitable containers, heavy garbage is kept to the bottom and lighter refuse is "worked" up to build out the load toward the top. The crew men alternate in the work of (a) bringing the cans to the truck and (b) sorting and piling the load as it accumulates.

Salvageable materials, in cartons or burlap bundles, are quickly passed to a salvage floor at truck-top level in the salvage and sorting warehouse located on the approach road to the sanitary fill, and before passing over the scales that determine the Sanitary Fill Company's charge for dumping. When each truckload is dumped at the spreading point, the resultant pile is large enough to make an economical load for the spreading bulldozer.

Even during the period of railroad delivery, good roadways with the main routes paved always have been maintained on this fill, because it was considered desirable expenditure in view of the continual movement of trucks delivering cover material. Trucks carrying refuse to the fill now have the benefit of a paved road on a well-compacted rock foundation. Anticipating the changeover from gondolas to motor trucks, this haul road was last year paved with a 4-in. asphaltic road-mix. The 20 to 25-ft. width of surfaced roadway permits higher truck speeds and hence less time spent on the fill. It has also decreased wear and tear on equipment and makes for lower engine maintenance costs.

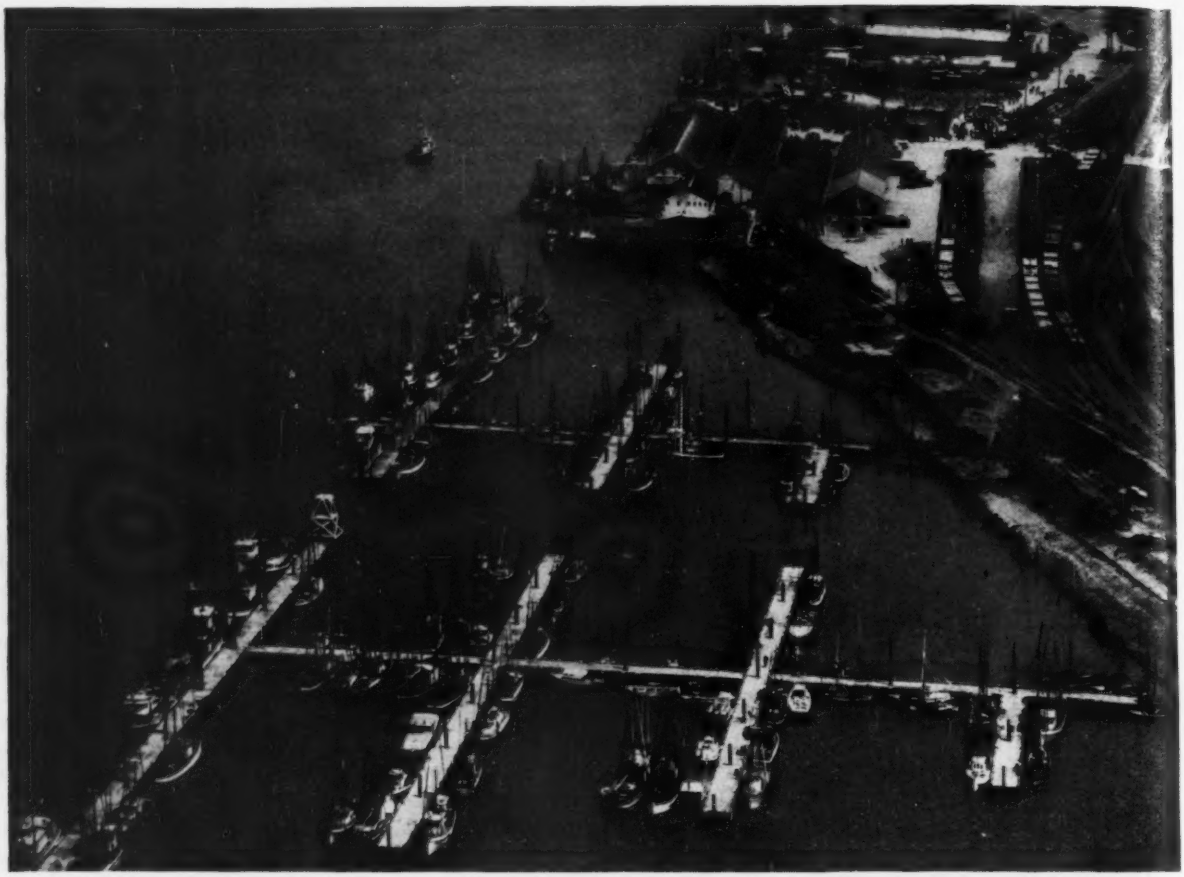


FIG. 1 MOORING SPACE for the fishing fleet is provided by ingenious use of Navy surplus pontoons at Eureka, Calif. No mooring lines needed; the piles on center lines hold floating structures in place.

Surplus Pontoons Make Boat Harbor

MOORING SPACE for a large fleet of fishing boats has been provided by the city of Eureka, Calif., through ingenious use of the 5x7x5-ft. Navy pontoon units that became so popular in the recent war. The city bought 774 of the surplus steel cells and at an overall cost of some $200,000, provided urgently needed mooring facilities for small craft.

The site available for the improvement was a triangular area with a 1200-ft. frontage on Humboldt Bay. Within this area, in which a relatively small amount of dredging was required, it was found possible to place two floating platforms, each with a series of wings as shown in the accompanying picture, that provide adequate mooring space for the small craft used in the fishing industry. Before this project was carried out not only was mooring space for the 200 fishing boats grossly inadequate, but they lost time in getting underway and damage was often sustained because of the necessity for mooring them three or four deep.

Boats unload at city wharves

The new mooring floats are in nowise loading wharves. The boats pick up their supplies and deliver their catch at the city's wharves, such as those in the background of the picture; the new facilities merely provide space for boats that are not in service. Shore access for personnel is maintained by ramps with sliding joints that automatically adjust to tide levels that range from −2 to +9. No anchor cables or tie lines of any sort are used; the pontoons are held in place by anchor piles spaced exactly 51½ ft. apart along the center line of the platforms.

These anchor piles were driven with the aid of jets as the first step in the construction program. After each pile had been cut off at the prescribed height, assemblies, or "floats," each consisting of seven pairs of pontoons, were floated into place and fastened by bolting on the steel angle brackets that enclose anchor piles at each end of the float.

The reasons for selecting the 51½-ft. spacing were chiefly (1) the need to provide for sufficient impact from wave action, considering size and weight of the floating structure and (2) an economical design for connections between pontoons. Piles driven on this spacing leave just enough clear space for seven pairs of the cells and their connections. Calculations

based on approximations of the several forces involved indicated a 50-ft. spacing as about right.

The bottom into which the piles had to be driven consists of sand overlaid with a stratum of mud. Mud thickness varies from two to six feet and since this was not considered as having any supporting value, the sand penetration requirement was for one-third the total pile length. In no case was the penetration to be less than 12 feet. Prior to driving piles the basin was dredged to minus nine feet which at extreme low tide of minus two feet left a seven foot available depth. This was adequate for boats expected to moor in the basin.

As to maximum movement of the floating structure, extreme high tide which some times reaches plus nine feet gives a total tidal range of 11 feet. Over this range the anchor piles were protected by four eight-foot strips of ½x2-in. steel from abrasion by the encircling steel collars. The collars welded to end cells of a pontoon assembly exert side pressure against these steel strips with which the piles are armoured. Pile tops were cut off 10 ft. above high water level.

Maximum tidal range governed design of the access ramp or walkway at the shore end of each floating structure. These ramps are provided on either side with steel plates in which slots 30 in. long provide for variation in length by sliding along over-lapped portions. The slots, 2½ in. wide, permit a free movement of the axle on either end of which 4-in. steel rollers move in a track formed by angles bolted to the plates above and below the slots.

Rigid connections between pontoons

The rigid connections between the two pontoons that made up a pair were made on shore so that each pair as a unit could be floated into the assembly or removed therefrom, in the simplest possible manner. Thus in case of damage at any point it will be possible to make immediate replacement of any pair of units from the spares kept for this purpose.

The construction program was to assemble in the water near shore seven pairs of the rigidly connected cells. This assembly or "float" was towed out into position, as a unit, in the original construction of the floating structure.

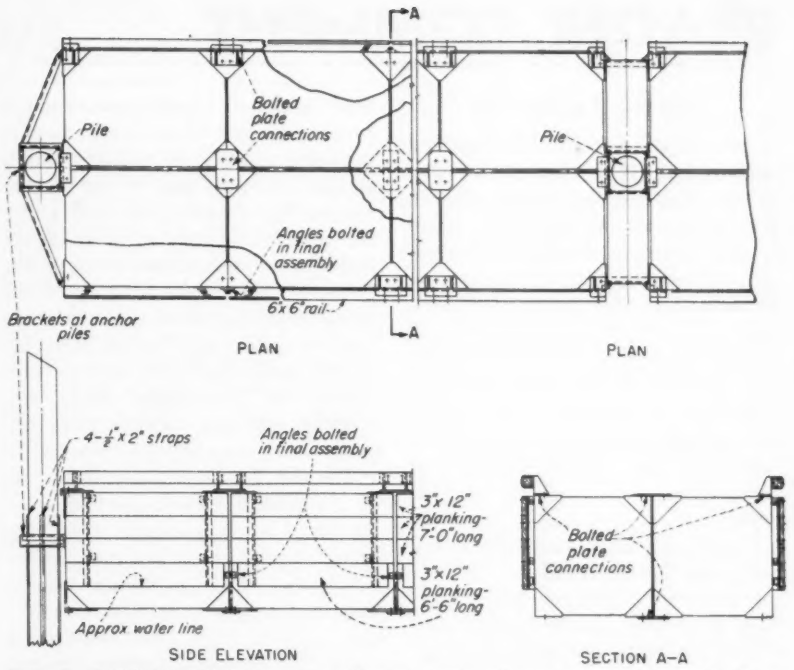


FIG. 2 CONNECTIONS between adjacent pontoons are made with steel plates, or brackets and angles or both. Removing six bolts frees each joint. Original assembly was made with "floats" each consisting of seven pairs of pontoons.

All pontoons and steel connecting plates are interchangeable except that cells adjacent to the piling, those where the portions of the structure intersect at right angles and, finally, the pontoons connecting with the ramps, have special attachments. Thus it is necessary to hold in reserve only four spare sets of two pontoons each to be able to replace any two-cell unit in the entire floating system. To make such a replacement it is only necessary to remove bolts in (1) top plates, (2) rail brackets and (3) side connecting angles at the bottom of the pontoons. This totals six bolts per joint; twelve bolts to free any pair of pontoons. All these bolts are readily accessible above water line.

Standard fittings used by the Navy in connecting the pontoon cells were not available.

However, it was a simple matter to adapt standard structural shapes, with welded or bolted joints, to make the desired connections without "jewelry," the common war-time term for the Navy's standard brass fittings for connecting the cells. A major consideration in designing these connections was to locate above water level the bolts for disconnecting pairs of cells. This simplifies inspection and maintenance as well as facilitating removal and exchange. From all indications thus far the connections are adequate and satisfactory.

The floating structure has shelter from all sides except from northwest winds. In that direction there is a clear expanse of open water for some 4,500 ft. Thus far the maximum height of waves from this direction has been about 3 ft., resulting in a vertical lift in the outer line of floats of about 1 ft. This is no more than the wave action created by passing craft moving at high speed and has not disturbed the floats to any great extent. Probably because of the weight of the steel cells, waves of this height affect only the outer line of pontoons.

According to George S. Winzler, Eureka city engineer, who designed the floating structure and from whom the foregoing data were obtained, it is significant that a community whose industrial interest primarily is in lumbering, should have approved the bond issue for the boat mooring project by a vote of 86 percent. This confidence is confirmed by a recent report of the U. S. Bureau of Marine Fisheries that indicates the fish "harvest" at Eureka has increased from some 5,000,000 lb. in 1943 to something over 20,000,000 lb. in 1947.

READER COMMENT

Railroad Engineering

Sir: In the editorial "A Half Century of Service" in the Aug. 5, issue of the Engineering News Record, you recognized the 50th anniversary of the American Railway Engineering Association and commented on its objectives and accomplishments. As president of the association, I express appreciation for the recognition given. While most of your comments in regard to the AREA are complimentary, some of those relating to the railroads and railroad engineering have serious implications.

If either the railroads or the AREA have been "ultra-conservative" it has not been to a detrimental degree. They have been constructively conservative not only through choice but through necessity. Operating without subsidy and under strict government regulations, the railroads have had to adopt and follow safe and sane policies. The recommended practices of the AREA have involved, to a great extent, the safety of life and property and it has shown prudence in recommending a safe and conservative yet progressive course. We do not contend that the AREA is a perfect organization but it has accomplished much and has abundantly justified its existence. Its 50th anniversary slogan "A past of achievement—A future of opportunity" fittingly expresses our evaluation of the past and our hopes for the future. We are willing to let the record of the AREA speak for itself.

I also wish to challenge the statement: "Along with the railroad companies the AREA has suffered as a result of the ending of the expansion of railways that began about the turn of the century * * * * and, more recently, from truck competition." The railroads have not constructed new lines in recent years to the same extent as they did in the last two decades of the past century, but they have not suffered, nor remained static on that account. Where a need developed, existing lines have been extended and new lines have been built, if financially justified. Our country is more adequately served with rail transportation than any other and our superb transportation system was one of the major factors contributing to our military might in the last war, and is one of the outstanding reasons why our country today is great. The railroads have worthy competitors in the transportation field and, in some situations, other forms of transportation have the advantage, but no fully informed individual will contend that within the foreseeable future the railroads will not continue to be the major mass-transportation agency.

The activities and accomplishments of the AREA show no evidence of decline. It is stronger today in every way, more active, more influential and held in higher esteem than ever before in its history.

C. H. MOTTIER
President, American Railway Engineering Association

Mr. Mottier's letter also raised question as to our statement concerning opportunities for young engineers in railroad engineering, which was the subject of letters from J. L. Gressitt and E. M. Hastings published in *ENR*, Sept. 2, p. 94. With his permission we have omitted that part of his letter.—EDITORS.

Paragraph Bungled

Sir: We have had called to our attention in your issue of Sept. 9, 1948 under the heading "Foreign Developments", a picture and outline of the New Tripler General Hospital in Honolulu, T. H. Your last paragraph, which states "the hospital was started by York and Sawyer, New York City architects, but was later turned over to Morrison-Knudsen Co., Inc. of New York, and Peter Kiewit Sons, Inc., for completion under Army direction . . ." does us an injustice and should be corrected.

The New Tripler General Hospital in Honolulu, T. H., was contracted for between the U. S. Corps of Engineers and the U. S. Army Surgeon-General's office in February of 1944, by means of a prime contract with the office of York and Sawyer. This contract was an architect-engineer management contract and called for both the architectural and engineering design for the various structures, as well as the management of all of the purchasing and construction of the job. For reasons of their own at that time, the U. S. Army did not wish to involve a general contractor in the work.

York and Sawyer, from their main office in New York and from a branch office in Honolulu, completed all of the architect-engineers work for the project, and were in complete charge of all of the contract work, subcontractors and the field organization until July 1, 1946, which was some time after the completion of the war. At this time, also for reasons of their own, the U. S. Army decided that there was no longer a reason for excluding a general contractor from work that rightfully belonged in that field. At that time, therefore, our contract was amended to give us what the Government calls, Title II, which in this case involved complete supervision and inspection of the work, covering a payroll in Honolulu of about 35 men.

In settling the terms of this change in our contract the government granted that we had completed over ninety percent of the actual subcontract purchasing for the entire operation, and that the construction of the structures was over fifty percent complete. This was entirely under the direction of York and Sawyer.

AARON N. KIFF
York and Sawyer
New York, N. Y.

Jet Fuel Damage Localized

Sir: It seemed to me your article relating to jet engine fuel damage to airport pavements *ENR* Aug 26, p. 3 was a fair statement of what takes place, but tended to be unduly alarming by its failure to show the extent of area affected. Had this been done, I feel the article would have been more useful and more comprehensive.

W. R. MACATEE
Manager, Airport Division
American Road Builders Association
Washington

EDITOR'S NOTE—Mr. Macatee is right. The damage is confined to the aprons, whose area is small compared to the total of airport pavement. It results from fuel spillage and, as the article stated, can be avoided by relatively simple measures.

BOOK REVIEWS

Boston Civil Engineers

CENTENNIAL ANNIVERSARY: 1848-1948 — *Journal* of the Boston Society of Civil Engineers, 715 Tremont Temple, Boston, Mass. $1.

Few people outside of New England realize that the oldest engineering society in America is the Boston Society of Civil Engineers, which was formally organized on July 3, 1848, four years before the organization of the American Society of Civil Engineers and only 20 years after the chartering of the Institution of Civil Engineers, the first of all engineering organizations.

The history of that society is recounted in a special supplement to the society's *Journal*. It is a record replete with the names of men who rose to national and international fame—Clemens Herschel, John R. Freeman, James Laurie, Allen Hazen, George F. Swain, Harrison P. Eddy—to name a few.

Like the American Society of Civil Engineers, the Boston society became inactive during the Civil War years and was not reconstituted until 1874. Since then it has taken an active part in stimulating the interchange of information among civil engineers in New England and in recording their accomplishments.

Revised Traffic Manual

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREET AND HIGHWAY TRAFFIC—Prepared by a joint committee of the American Association of State Highway Officials, Institute of Traffic Engineers and the National Conference on Street and Highway Traffic and published by the Public Roads Administration. 223 pp. Obtainable from the Superintendent of Documents, Washington 25, D. C. Price 50c. (Discount of 25 percent on orders over 100).

This new manual supersedes the 1935 and 1942 manuals and contains many noteworthy improvements over the latter manual in the way of presentation of the standards. Color has been used in diagrams showing the recommended methods of lane marking, and the diagrams indicating the correct positions for traffic signs are greatly improved.

The manual has been characterized by Commissioner Thomas H. MacDonald of the Public Roads Administration as implementing Section 12 of the Federal-Aid Highway Act of 1944, which grants broad powers to the PRA over the marking and signing of highways built with federal aid. This indicates that the PRA will use its influence to bring about adoption of these standards by states, counties and cities that have not yet adopted them.

Zoning Complications

ZONING IN NEW YORK—By Latham C. Squire 95 pp. Home Title Guaranty Co., New York. $4.

The New York City zoning resolution was the first comprehensive zoning ordinance adopted in the United States. It was originally complicated, but has become much more involved by the many amendments since its adoption in 1916. Mr. Squire's book should prove a valuable aid to all those architects, engineers, and many others who must conform to its provisions in the structures which they design and build.

The volume gives detailed comments on the meaning and application of each section and paragraph of the resolution, supplemented by diagrams and by tables summarizing the height and area provisions.

The design of multi-family buildings in New York City is complicated by the fact that the zoning regulations are supplemented by those of the Multiple Dwelling Law and superseded by the latter where it is more restrictive. The provisions of this law are also given and their application fully explained and illustrated.

The work is authoritative as the result of Mr. Squire's long experience in this field and the cooperation he received from those city agencies which are responsible for the administration of zoning and building regulations. A foreword by Harris H. Murdock, chairman of the Board of Standards and Appeals, points out the need of such a volume to bring up to date a somewhat similar work prepared by the late George B. Ford in 1929. Mr. Murdock states that a good zoning ordinance should be "clear and concise" and not complicated by "too many types of districts". These are handicaps of the present ordinance which the city is now in process of revising.

A brief statement is included on "Zoning in Nassau County", summarizing the provisions of the state enabling acts (applicable to all municipalities in New York State) and giving the special zoning provisions in the Nassau County Charter.—*Reviewed by* HAROLD M. LEWIS, *Consulting Engineer*, New York.

More on Soil Mechanics

SOIL MECHANICS: ITS PRINCIPLES AND STRUCTURAL APPLICATION—By Dimitri P. Krynine, Second Edition. 511 pp. McGraw-Hill Book Co., New York 18, and London. $5.50.

FUNDAMENTALS OF SOIL MECHANICS—By Donald W. Taylor 700 pp. John Wiley & Sons, New York; Chapman & Hall, London. $6.

Three new books on soil mechanics have appeared during the past year, thus helping to supply the lack of up-to-date texts on a subject that is interest to a wide variety of engineers. The first was a new edition of Prof. Krynine's text book, which was published originally in 1941. Although considerably thinner than the first edition, the second edition has more pages, due to the use of thinner paper, and covers a wider field. New chapters on "Pressure on Tunnels and Conduits" and "Highway and Runway Subgrades" have been added, and some rearrangement of the other parts has been made to improve the usefulness of the book either as a text for students or by practicing engineers.

The second book was "Soil Mechanics in Engineering Practice" by Karl Terzaghi and Ralph B. Peck (*ENR* June 10, 1948, vol. p. 974), the long-awaited compliment to Dr. Terzaghi's "Theoretical Soil Mechanics", which was published in 1943. As the title of the new Terzaghi book indicates, it is directed toward aiding in the practical application of the principles set forth in his earlier text.

Prof. Taylor's "Fundamentals of Soil Mechanics" is directed to a new and growing group of engineers and physicists, the graduate students who seek to gain a more complete understanding of the fundamentals of soil

mechanics than can be obtained in undergraduate courses. Due to the fact that the author has tied theory closely to practical application throughout the text, the book also should be useful to practicing engineers as well as to students doing post-graduate work.

Fire Protection Manual

NEPA HANDBOOK OF FIRE PROTECTION—Tenth Edition, by NFPA staff and consultants, Robert S. Moulton, Editor. 1,544 pp. 1,359 illustrations. National Fire Protection Association, 60 Batterymarch St., Boston, Mass. $9.50 (members $7).

The best current thoughts of fire-protection experts have been incorporated in this handbook, which has been completely rewritten. New subjects include chapters on chemistry and physics of fire, water spray (fog) protection, causes of fires, and building construction. Much of the new material on buildings is devoted to interior finishes, insulation, flame-proofing treatments and fires resistance ratings of structural components. There is also information on the properties, hazards, proper storage practices and best extinguishing methods for many chemicals.

Malaria Control

MALARIA CONTROL ON IMPOUNDED WATER—United States Public Health Service and Health and Safety Dept., Tennessee Valley Authority. 422 p. Superintendent of Documents, Washington 25, D.C. $2.00.

Prepared cooperatively by the scientists and engineers of the U. S. Public Health Service and the Tennessee Valley Authority, this text is a report on the comprehensive experience of these agencies in the design and operation of malaria-control programs on artificial reservoirs. Its purpose —"to present the basic principles and the modern practices of malaria control on impounded water"—is effectively accomplished by emphasizing the practical application of engineering, epidemiological and biological aspects to the problem as a whole.

Some of the more important chapters of this tightly written manual are: Malaria and Its Relation to Impounded Water; Planning Malaria Control; Reservoir Preparation; Permanent Marginal Measures; Water Level Management; Shore-Line Management and Facilities and Operation Procedures. Other sections discuss larviciding, mosquito-proofing and house spraying.

The final chapter describes application of control measures to small reservoirs where problems and preventive procedures differ considerably from those employed on large bodies of water. Black-and-white as well as colored photographs are profusely scattered throughout the text to illustrate the points made. Tabulations of engineering and cost statistics, graphs, detail drawings, maps and sketches provide valuable reference material.

This volume should be on the book shelf of every engineer, medical officer, malariologist and governmental executive engaged in the control and prevention of malaria.

Miscellaneous Notes on Booklets and Reprints

RECOMMENDED PRACTICE FOR WINTER CONCRETING METHODS, a report by Committee 604 of the American Concrete Institute, is published in the September, 1948 *Journal* of the institute. Copies of this issue can be obtained from the institute office, New Center Building, Detroit 2, Mich., for $1.25. Related information is found in REPORT OF THE COMMITTEE ON TREATMENT OF ICY PAVEMENTS AND SNOW REMOVAL, which is published as Technical Bulletin No. 145, American Road Builders Association, International Building, Washington 4, D. C.

FRENCH ROADS are described in a dozen authoritative articles on road construction in France which appear in the 1948 edition of *Route*, published annually since 1926 as a supplement to the magazine *Travaux*. Containing 135 pages, this pamphlet is available from P. Le Prince, Director, 6 Avenue Pierre-1er-de-Serbie, Paris. Price 375 francs.

IRRIGATION CHANNEL SEEPAGE LOSS, studies covering a quarter century, are detailed in a 100-page Colorado Agricultural Experiment Station bulletin by Carl Rohwer and Oscar Van Pelt Stout. The importance of the problem is emphasized by findings that with 4 percent of all ditches and laterals artificially lined, 38 percent of all water diverted was lost before it reached the farm. In some sandy soils, deposition of fines greatly lowered the permeability, and some heavier soils had unexpectedly high permeability. Because canal conditions could alter the permeability of surrounding soils, full-scale measurements of loss from dammed-up canal sections were deemed the best test method. Most of the studies were conducted in California. Technical Bulletin No. 38 is available at 50 cents from the Office of Information, Colorado A. & M. College, Fort Collins, Colo.

New Engineering Books

THE QUEST FOR PURE WATER: The History of Water Purification from the Earliest Records to the Twentieth Century—By M. N. Baker. 527 pp. American Water Works Association, 500 Fifth Ave., New York. $5.

ENGINEERING CONTRACTS AND SPECIFICATIONS—Second Edition—By Robert W. Abbett. 327 pp. John Wiley & Sons, New York 16. Chapman & Hall, London. $3.75.

1947 PROCEEDINGS TWENTY-SEVENTH ANNUAL MEETING HIGHWAY RESEARCH BOARD—Vol. 27—By Division of Engineering and Industrial Research, National Research Council, Washington, D. C. 523 pp. $7.50.

MECHANICS OF MATERIALS— By Glenn Murphy. 310 pp. Irwin-Farnham Publishing Co., Chicago, Ill. $4.50.

CONCRETE MATERIALS AND PRACTICE—By L. J. Murdock. 328 pp. Edward Arnold & Co., London, Longmans Green & Co., New York. $5.25.

PUBLIC HEALTH ENGINEERING—Vol. I—By Earle B. Phelps. 655 pp. John Wiley & Sons, New York 16. Chapman & Hall, London. $7.50.

ESTRUCTURAS DE EDIFICIOS—By Carlos Fernandez Casado. 347 pp. Editorial Dossat, S. A., Plaza de Santa Ana 9, Madrid, Spain. 200 pesetas (Approx. $17.83).

MANUAL OF REPORT PREPARATION—Correspondence and Technical Writing—By Frank Kerekes and Robley Winfrey. 397 pp. Wm. C. Brown Co., Dubuque, Iowa.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES—By Committee on the Metric System, The National Council of Teachers of Mathematics, Columbia University, 303 pp. Bureau of Publications, Teachers College, Columbia University, New York. $3.

(*Continued on p.* 138)

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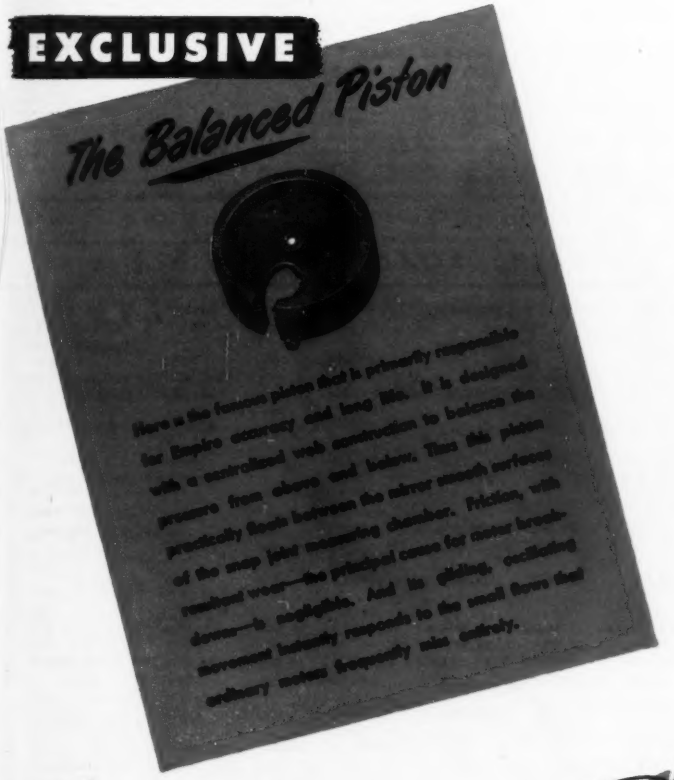


There is no substitute for experience. For over 64 years water meter users have experienced complete measurement satisfaction from the Empire design. Precision and durability are the *plus* values that meter buyers have learned to expect. And remember, today's Empire meters are even better constructed than those made in the past. Investigate metering the Empire way. You'll get *lasting accuracy* for the *longest life* at the *lowest cost*. Write for bulletins.

PITTSBURGH EQUITABLE METER DIVISION
ROCKWELL MANUFACTURING COMPANY
Pittsburgh 8, Pa.

Atlanta Boston Chicago Houston Kansas City Los Angeles
New York Pittsburgh San Francisco Seattle Tulsa

Empire OSCILLATING PISTON Meters

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents
November Materials and Labor Prices will appear in the November 11, 1948 issue

CEMENT, AGGREGATE, READY-MIXED CONCRETE — F. O. B. CITY

	PORTLAND CEMENT* Per bbl. C/L lots incl. $1.00 per bbl. for bags, cash. dis. not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block		READY-MIXED CONCRETE 1:2:4, over
	Cloth	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand gray.	Lt.wgt.Agg.	50 c.y. del.
Atlanta	$4.11	$3.34	$3.05	$2.00	$2.00	$1.75	$2.10	$2.10	$1.65	$1.85	$0.1725	$0.1725	$11.00
Baltimore	4.12	3.35	3.06	2.30ff	2.30ff	1.95ff	2.60ff	2.70ff	2.45ff	2.45ff	.16	.16w	9.85
Birmingham	3.80	3.05	....	2.06	2.06	1.66	2.50	2.50	1.00	1.20	.165	.165	7.75
Boston	4.64	3.87	3.57	2.50t	2.50t	2.50t	1.50t	1.60t	....	....	.17	.185w	10.50w
Chicago	4.05§	3.28§	3.00§	2.75‡d	2.75‡d	3.20‡d	2.75‡d	2.75‡d	2.00‡	2.00‡	.20	.20x	....
Cincinnati	4.00	3.23	2.94	1.85‡pp	1.85‡pp	1.75‡pp	2.95‡bb	2.95‡bb	2.30	2.30	.19	.195	10.40dd
Cleveland	3.87	3.10	2.77	1.90lly	1.65lly	1.55ll	3.55‡h	3.55‡h	2.60	2.60	....	.21	11.80aa
Dallas	3.57	2.80	2.52	2.00	2.15	1.75	2.10	2.15	....	....	.0775p	.285	8.85
Denver	....	3.59	3.29	1.85	2.00	1.15	....	....	....	....	.20	.2175w	9.65
Detroit	3.93	3.15	2.87	3.25‡	3.25‡	3.00‡	3.00‡	3.00‡	3.00‡	3.00‡	.17	.18w	10.05dd
Kansas City	....	....	....	2.05	2.05	1.50/1.80t	1.45q	1.45q	....	....	.17wf	....	9.85n
Los Angeles	....	3.72h	3.34h	1.92t	2.02t	1.72tnn	1.92t	1.92t	....	....	.085oo	....	9.96m
Minneapolis	4.05dd	3.30dd	3.00dd	2.30h‡j	2.30h‡j	1.35h‡j	2.50h‡j	2.50h‡j	....	....	.21ee	....	10.30hh
Montreal	....	2.39rqq	2.24rqq	....	1.95bbs	....	.85cs	1.10cs	....	....	.177rr	.1665urr	8.95ii
New Orleans	....	2.88	2.60	2.32	2.32	1.82	....	....	.90	1.15	.23	....	10.65
New York	....	4.20‡	....	2.00de	2.00de	1.45de	2.00de	2.00de	....	....	.18ii	.18wcii	10.30h
Philadelphia	4.15‡	3.38‡	3.10‡	2.30‡	2.40‡	2.05‡	1.90‡	1.95‡	1.50	1.50	.18/.22	.18/.22w	9.85
Pittsburgh	3.79	3.02	2.74	2.05‡	2.05‡	2.35‡	2.50‡	2.50‡	2.05	2.05	.22s	.22s	11.00
St. Louis	3.80o	3.03o	2.75o	2.40/2.60‡oh	2.40‡oh	2.00/2.40‡oh	1.50c	1.50c	1.10	1.15	.215	.23yo	10.40
San Francisco	.....	3.38	2.98	1.84	1.84	1.94	1.94	....	....	....	....	.25y	10.75n
Seattle	.....	3.45mm	2.95mm	2.75‡ed	2.75‡ed	2.75‡od	3.50‡od	3.50‡od	....	....	.22o	....	9.75o

‡ Delivered. *a* F.o.b. truck at plant. *b* 10c. per bbl. off for payment by 10th of following month. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks, Man. *f* F.o.b. truck on job. *g* Pea gravel. *h* Truck Lots. *i* ¼ in. *j* 5% discount for cash. *k* 5 cu. yds. or over, del. Man. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* F.o.b. truck at plant. *r* 10¢ per bbl. off cash 20 days. *s* Sales tax included. *t* Truck delivery. *u* 10 to 100 c.y. brackets. *v* F.o.b. scow, Hudson River, N. Y. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Aver. haul, 7–9 mi. zone. *bb* Under 5 tons. *cc* 8 x 8 x 18 in., also. *dd* Dealers sell only in LCL. This is price for CL and does not include dealer's commission. *ee* 20c refund for each returnable bar. *ff* LCL. *gg* 10c. refund for each returnable bag. *hh* Truck loads up to 500 c.y. Over 500 c.y. lots, 50¢ less per yd. *ii* Yard price. *kk* 2500 lb. compression strength. *jj* 30¢ refund for each returnable bag. *ll* Price at plant, called for. *mm* 10¢ per bbl. off cash 10 days. *nn* Concrete sand. *oo* 4 x 8 x 12 std. wgt. *pp* 5 tons or more. *qq* Dealer's commission not included. *rr* F.o.b. *Prices include dealer's commission except where indicated to the contrary. § Maximum prices. Sales at lower levels. † Sept. price of $10.60 was for smaller quantities.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICES AT CEMENT MILLS

Charge for bags not included. For cloth bags, add $1.05 per bbl.; 25¢ refund allowed for each returnable bag; for paper bags add 28¢ per bbl., not refundable.

	Bulk		Bulk		Bulk		Bulk
Richard City, Tenn.	$2.25	Independence, Kan.	$2.30	Duluth, Minn.	$2.30/2.40	Harrys, Tex.	$2.15
Clinchfield, Ga.	2.25	Hannibal, Mo.	2.20	Hudson, N. Y.	2.25/2.30	Manchester Switch, Tex.	2.25
Kingsport, Tenn.	2.25	Northampton, Pa.	2.30	North Birmingham, Ala.	2.10	South Norfolk, Va.	2.45
West Des Moines, Iowa	2.30	Universal, Pa.	2.20	Spocari, Ala.	2.20	Alpena, Mich.	2.25
Nazareth, Pa.	2.25/2.30	Waco, Tex(+ 9¢ tax)	2.20	Limedale, Ind.	2.20	Detroit, Mich.	2.40
Bath, Pa.	2.30	Steelton, Minn.	2.40	Bonner Springs, Kan.	2.30	Muskegon, Mich.	2.40
Buffington, Ind.	2.20	Leeds, Ala.	2.10	New Orleans, La.	2.35	Saginaw, Mich.	2.35

	Bulk
Wyandotte, Mich.	$2.2
Buffalo, N. Y.	2.4
Oswego, N. Y.	2.4
Cleveland, O.	2.4
Toledo, O.	2.4
Milwaukee, Wis.	2.4
Ironton, O.	2.2

Montreal City (Discount 10¢ per bbl. 20 days), $2.08.

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS — F. O. B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT Per ton, less than 80 penetration		ASPHALT BINDERS—FLUXES Per gal., 80–300 penetration		CUTBACK ASPHALT Per ton		ROAD OIL Per gal.	ASPHALT EMULSION (Quick-breaking) Per gal.	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baltimore	150.00‡	52.70‡	.....	$23.00	.....	$.095	$0.15	$.095h	$.17h	$.095v	$.095	$0.115
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	.....	.....	.....	23.00o	$34.00o	.0936o	.175o	.095hlo	.185hlo	.095o	.103o	.195o
Chicago	150.00‡y	85.00/88.00e‡	3.10/4.15d‡	22.50b	32.00b	21.80bg	31.00bg	.097/.10bh	.....	.082/.0845b	.0925/.1025b	.14/.165b
Cincinnati	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	190.00	49.00f	3.87u	30.00	40.00	29.50g	39.50g	.135h	.22h	.14	.20	.27
Dallas	‖	40.00	‖	23.38	42.17	.0987	.1837	26.15	46.65	.0962	.1037	....
Denver	.....	41.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	....	.....	.....	27.00	26.00	18.40g	24.40g	.0811h	.128h	.075	.1085	.1525
Kansas City	.....	40.00g	.....	20.45r	.....	.....	.....	.081hr	.....	.071r	.....	.....
Los Angeles	‖	.....	‖	17.50mf	32.00mfw	17.50gm	32.00mw	18.50m	25.50mw	17.00gm	.075cc	.145cc
Minneapolis	.....	.....	2.79d	28.00	37.00	23.00g	34.00g	27.00	38.00	.105	.13	.23
Montreal	140.00	.....	.....	25.00k	34.65k	15.70kp	19.95kp	15.30kp	17.30kp	14.20kj	.174k	.215k
New Orleans	.....	.....	.....	20.00a	.....e	20.00pa	.....e	.095hadd	.....e	.095	.0975	.16a
New York	.....	.....	2.50d	26.50	38.86	25.50g	44.88g	.1090h	.1917h	.1040	.1090	.1897
Philadelphia	150.00	75.00	4.06	23.00	.....	22.00g	.....	.095h	.....	.....	.....	.....
Pittsburgh	165.00	42.00	4.50	26.00	39.00	.12	.24	27.00	40.00	.095	.10	.21
St. Louis	.....	.....	.....	21.40	.....	.....	.....	.....	.....	.....	.1025	.....
San Francisco	.....	57.75c	.....	17.50ee	32.00wee	17.50geeff	.....	19.50ee	.....	.....	.0725	.1425
Seattle	.....	.....	.....	16.50i	33.00i	15.00ig	.....	18.00i	22.00nni	16.00ig	.0675i	.0825

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. refinery. *c* 2½ x 8½ x 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½. *f* 40–80 penetration. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* Shipped in drums, per drum. *k* Tax included. *l* Not used. *m* F.o.b. refinery, El Segundo. *n* 55 gal. drums. *o* Price at plant, in Everett. *p* Per 100 gal. *q* F.o.b. Buffalo. *r* F.o.b. Sugar Creek, Mo. *s* Drums not available. *t* Truck deliveries in Greater Cleveland. *u* 3-in. *v* Bulk, refinery. *w* Shipped in steel barrels no longer in double head wood barrels. *x* Truck deliveries in Detroit $75.00. *y* Carload lots. *aa* In customer's drums. *cc* F.o.b. refinery, Inglewood. *dd* Medium curing. Rapid curing, $.0975; slow curing, $.0925. *ee* F.o.b. Richmond. *ff* 50–300 penetration.

IRON AND STEEL PRODUCTS—PER 100 LBS. BASE MILL PRICES

	STRUCT. SHAPES–PLATE	REINF. BARS billet *ab*	RIVETS ½-in. structural	SHEET PILING Base	STEEL RAILS Per Net Ton Standard	Light *c*	Re-rolled	TRACK SUPPLIES Angle Bars	Std Spikes	Tie Plates	Track Bolts *d*
Birmingham Area	$3.25	$3.35	$6.75	....	$64.00	$71.00/85.00	Not	$4.25	$5.35	$4.05	....
Chicago Area	3.25	3.35	6.75	$4.05	64.00	71.00/85.00	avail-	4.25	5.35	4.05	....
Pittsburgh Area	3.25	3.35	6.75	4.05	64.00	71.00/85.00	able	4.25	5.25	4.05	....
Buffalo Area	3.30	3.35	6.75	4.05	64.00	71.00/85.00	....	4.25	5.35	4.05	$8.50
Cleveland	....	....	6.75	....	.....	.....	....	....	....	....	8.50
Youngstown Area	....	3.35	....	....	.....	.....	....	....	5.35	....	....
Geneva	3.25	....	....	....	.....	.....	....	....	....	....	....
Los Angeles	3.25	4.10	....	....	.....	.....	....	....	5.35	....	....
Pueblo	3.25	3.35	....	....	64.00	71.00/85.00	....	4.25	5.35	4.05	8.50

a To fabricators. To consumers: $4.10; except $4.25 S. Duquesne, Pa., Gary, Ind., Youngstown, O.; $5.00 Seattle, Wash. *b* Rail steel price $4.65; except $5.25 Huntington, W. Va. *c* Rail steel $94 per ton Williamsport, Pa. *d* Treated. Untreated $8.25.

IRON AND STEEL PRODUCTS—F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb. base price	REINFORCING BARS *g* Per 100 lb., base price *u* 5 tons to carload lot *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH *k* Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING ‡ Per 100 sq. ft., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires	SHEET PILING Per 100 lb. base price
Atlanta	$4.75	$5.225*k*	$5.225*k*	$.025	$.10	$31.50	$33.50				....
Baltimore	5 48	4.47*l*	....	....	.10	37.00	45.00				..
Birmingham	5 15	5.15	5.50	.05	.15	43.00*p*	45.50*p*				....
Boston	5.54*k*	5.46*k*	4.84*kc*	....	.10/.15	31.00	33.00				$4.05*a*
Chicago	5 05	4.20/4.70*ff*	4.20/4.70*ff*	.05	....	31.00‡	33.00‡				4.05*a*
Cincinnati	5 60‡*r*	5.55*r*	....	....	....	33.00*see*	35.00*see*				4.05*a*
Cleveland	5.45*hh*	4 37*s*	....	....	.10	34.50	36.50				....
Dallas	6 30	6.25	6.25	....	....	33.75	35.75				....
Denver	6.45	6.30*e*	....	....	....	43.00*s*	50.00*qs*				6.39
Detroit	5.45	....	....	....	.10	33.50*x*	35.50*q*				4.462*yee*
Kansas City	6.00	4.75*a*	....	....	....	.....	.....				4.65*d*
Los Angeles	5.70*f*	6.10*bb*	....	....	.15	44.00*f*	49.00*kk*				.....
Minneapolis	5 94‡	6.19*ccn*	6.19*ccn*	...	.15	34.50	36.50				4.05*a*
Montreal	5.10*i*	4.70*i*	4.70*i*	....	....	44 10*h*	46.80*h*				79.90*jdqq*
New Orleans	....	5.00*oh*	....	.05	.10	32.00	32.00				.....
New York	5 68*r*	5.75	....	....	.15/.20	34.50*st*	36.50*st*				4.05*a*
Philadelphia	5 04	5.15	....	....	....	30.00‡	32.00‡				....
Pittsburgh	4 40/4.50	4.40/4.50	4.40/4.50	.05	.10	32.50	34.50				....
St. Louis	5 39*k*	5.24*c*	5.24*c*	....	....	42.00*aa*	48.00*aa*				....
San Francisco	5.90*ii*	5.65	....	....	....	36.50	38.50				5.25
Seattle	4.30*e*	5.25*el*	....	....	....	52.00*s*	42.00*s*				5.31*dd*

F.o.b. Mill: Joliet, Illinois, Donora, Penn., $2.36; Monessen, Penn., $2.40 — F.o.b. Mill: Joliet, Illinois, Donora, Penn., $1.63; Monessen, Penn., $1.66 — F.o.b. Mill: Joliet, Illinois, Donora, Penn., $2.47; Monessen, Penn., $2.52

‡ Delivered. *a* Mill prices. *b* 1–5 tons, add 35c. Less than 1 ton, add 50c. *c* 20 tons or over base. *d* Mill price plus freight. *e* F.o.b. plant. *f* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15c. differences between new billet and rail steel. *h* List price. Dominion tax exempt. Provincial and Municipal tax extra. *i* Plus Dominion, Provincial and Municipal sales tax. *j* Price per ton. *k* F.o.b. city. *l* Intermediate and hard grade, new billet. *m* Per sq. yd. *n* 5 to 8 tons base. *o* 5 to 15 tons base. *p* Del. of 5000 sq. yd. or less. *q* Std. ribbed. 4 lb. per sq. yd. *r* 5 tons or over. *s* LCL. *t* Asphalt coated. *u* Note: Revised size extra—1 in., 1 ¼ in., 1 ½ in. 10¢, ¾ in., ⅞ in. 15¢, 1 in. 20¢, 1 ¼ in. 35¢, 1 ½ in. 55¢, 2 in. $1.30. *v* Under 20 tons. Straight. *w* Copper bearing. *x* 2.5 lb. per sq. yd. *y* $.0093 transportation tax included. *z* Copper alloy. *aa* Delivered truck to job. Contractor to do unloading. *bb* Includes 55¢ extra for ¼ in. size. *cc* F.o.b. cars Chic. plus freight. *dd* F.o.b. dock. *ee* F.o.b. cars. *ff* Carload lots. *gg* Including sales tax. *hh* Delivered price is $5.60. *ii* Rolled at Geneva mill. *kk* ½" ribbed.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, Delivered ASTM C13–44T std. 8 in. s.s.	std. 12 in. s.s.	24 in.	36 in.	CLAY DRAIN TILE ASTM C4–24 Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered; ASTMC 14–41 12 in.	24 in.
Atlanta	$100.10	$0.43	$0.67	$3.39	$7.00	$114.00	$140.00	$0.45	$2.00
Baltimore	104.50	.378	.729	3.105	8.098	147.00	228.00	.80	2.20
Birmingham	93.50	.40	.72	2.84	....	210 00‡	375.00‡	.90	2.50
Boston	107.90	.441*usx*	.8505*usx*	3.87*usy*	10.36*usy*	173.40	267.60	1.45‡*mq*	3.60‡*mq*
Chicago	106.70	.59	1.14	4.81	13.45	150.00‡	270.00‡	.70	2.35
Cincinnati	105.20	.441	.8505	3.51	9.53	154.80‡	241.20‡	.60	2.25
Cleveland	107.30	.357*z*	.6885*z*	2.975*z*	9.405*z*	147.50	231.00	.65	2.50
Dallas	109.08	.365	.684	2.72	6.25	109.00	131.00	.48	1.55
Denver	113.92	.41*dd*	.71*dd*	2.98*dd*	....	.....	.....	.74*dd*	2.50*dd*
Detroit	107.30	.553	1.07	4.185	12.63	195.00‡*m*	303.00‡*m*	.65	2.50
Kansas City	108.42	.418*m*	.76*m*	3.00*m*	.....	221.00*m*	418.00*m*	.60*l*	2.00*l*
Los Angeles	120.30	.426	.927	4.532	11.298	193.00‡	324.60‡	.65	...
Minneapolis	110.30	.62*mo*	1.12*mo*	4.35*mo*	11.290	.....	.....	1.23*h*	3.50*h*
Montreal	90.00	.73*s*	1.28*s*	4.20*z*	6.80*es*	.....	.....	72.00*jkaa*	218.00*jkhaa*
New Orleans	103.10	.412	.762	3.955	9.15	231.00*bb*	.....	.55	1.95
New York	103.50/108.50	.62	1.14	4.45	12.30	.....	.....	1.00	2.25
Philadelphia	101.30	.54	.99	4.08	10.25	235.00‡	300.00‡	1.25*h*	3.20*h*
Pittsburgh	107.82	.364*m*	.702*m*	2.70*m*	6.625*m*	130.20	197.40	1.05*h*	2.50*g*
St. Louis	104.60	.48	.87	3.42	8.05	.....	.....	1.10*il*	2.25*hl*
San Francisco	120.30	.450*d*	.99*d*	3.96*d*	9.90*d*	188.00*dl*	313.00*dl*	.69	2.85
Seattle	122.10	.51*b*	.91*b*	....	....	150.00*e*	.....	.80	2.40

*WROUGHT STEEL PIPE (Full standard weight)

Mill	3½ to 6 in., Lap Weld† Black %	Galv. %	2½ & 3 in., Butt Weld† Black %	Galv. %
Lorain, Pa.	....	27*a*	....	....
Aliquippa, Pa.	....	26	....	....
Sparrows Pt., Md.	46.5*a*	....	50.5	34.5
	42.5	....	49.5	30.5
	48.5	....	48.5	32.5
Benwood, W. Va.	44.5	25	50.5	31.5
Youngstown, O.	42.5	....	50.5	31.5
Indiana Harbor, Ind.	....	23	49.5	30.5
	46.5*a*	27*a*	48	29
Sharon, Pa.	44.5	25	49.5	30.5
Wheatland, Pa.	12.5*ab*	7*ab*	50.5*b*	31.5*b*
Etna, Pa.	....	....	19.5*b*	0.5*b*
Fontana, Calif.	....	....	....	....

b Continuous †Threaded and coupled. *a* 3½ to 4 in. weld.

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, CL, Burlington, N. J. (base) $98.50. Based on existing freight rates; subject to rate change. Gas pipe and class A, $5 per ton additional. 4 in., $5 per ton additional, 30 in. and larger, usually $1 per ton less. *b* Extra strength ASTM C 200–44T. *c* 4-in., $90. *d* SS361-A. *e* 30 in. *g* Culvert pipe. Reinforced, ASTM C76–41. *h* Reinforced. ASTM C75–41. *i* Reinforced. ASTM C76–37. *j* Centrispun. *k* Per 100 ft. *l* F.o.b. plant. *m* Truck delivery. *o* Listed price is based on LCL (no minimum). *p* Less than 5 ton loads, price per ft. *t* Within switching limits. *u* ASTM C13–40. *v* F.o.b. city. *x* 2 ft. lengths. *y* 3 ft. lengths. *z* CESA A 60–1941 specifications used. *aa* No standard specifications in Can. *bb* Freight allowed to destination in city. *cc* Truck loads; f.o.b. plant, Newton. *dd* LCL, delivered, f.o.b. truck.

*WROUGHT STEEL PIPE: Discounts from standard list consumers carload prices. Base price approx. $200 per net ton. List prices per ft.: *Butt Weld:* ¼ in., 5½¢; ⅜ in., 6¢; ½ in., 6¢; ¾ in., 8½¢; ¾ in., 11½¢; 1 in., 17¢; 1¼ in., 23¢; 1½ in., 27½¢; 2 in., 37¢; 2½ in., 58½¢.; 3 in., 76½¢. *Lap weld:* 3½ in., 92¢; 4 in., $1.09; 5 in., $1.48; 6 in., $1.92. Freight rates to destination to be added to price, plus 3 percent tax on transportation.

WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. *Butt weld* — 1 in. and 1¼ in. black, +4.5, galv. +30; 1½ in. black, 1.5, galv. +26.5; 2 in. black 2, galv. +26. *Lap weld* — 2½ in. to 3½ in. black + 5, galv. +29.5; 4½ in. to 8 in. black + 2, galv. +25. Freight rates to destination to be added to name delivered price.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F. O. B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face)								LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)											
	1x6 s4s	1x8 s4s	2x4 s4s	2x6 s4s	2x8 s4s	2x10 s4s	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	¾"	¾"
Atlanta	$70.00	$71.00	$60.00	$62.00	$65.00	$68.00	$70.00	.....	.....	.....	.....	$22.32	$27.24
Baltimore	90.00	95.00	92.00	95.00	95.00	98.00	115.00	.....	.....	175.00	175.00	22.86	27.90
	120.00	*120.00*	*115.00*	*115.00*	*115.00*	*115.00*	*125.00*	*125.00*	*125.00*	.....	.....	.....	.....
Birmingham	87.50	90.50	75.00	78.00	80.00	82.50	105.00	.....	.....	130.00	125.00	21.78	26.58
	80.00	*80.00*	*75.00*	*75.00*	*75.00*	*75.00*	*85.00*	*85.00*	*85.00*	.....	.....	.....	.....
Boston	80.00[1]	80/85[1]	85.00[1]	85.00[1]	85.00[1]	90.00[1]	100.00[1]	.....	.....	.....	.....	22.86	27.90
	100.00	*100.00*	*102.00*	*85.00*	*85.00*	*105.00*	*105.00*	*105.00*	*105.00*	105.00	105.00	.....	.....
Chicago	90.00	95.00	80.00	85.00	87.00	93.00	100.00	.....	.....	120.00	120.00	18.72	22.80
	103.00	*108.00*	*100.00*	*100.00*	*100.00*	*105.00*	*105.00*	*105.00*	*105.00*	.....	.....	.....	.....
Cincinnati	102.00	105.00	105.00	102.00	108.00	115.00	.....	.....	.....	145.00	145.00	21.78	26.58
Cleveland	83/84	87/89	74/78	81.00	84.50/85.50	91.00	.....	.....	.....	.....	.....	22.20	27.12
Dallas	71.00	71.00	61.00	59.00	61.00	66.00	80.00	.....	.....	72.00	80.00	18.72	22.80
Denver	*101.00*	*101.00*	*113.00*	*110.00*	*110.00*	*111.00*	*111.00*	*130.00*	*139.00*	.....	....	13.92	16.98
Detroit	83.50	87.50	82.00	84.00	87.00	97.00	.....	.....	.....	.....	.....	21.78	26.58
	90.00	*90.00*	*88.50*	*86.00*	*86.00*	*86.00*	.....	.....	.....	.....	.....	.....	.....
Kansas City	110.00	110.00	100/103	100/103	105.00	105.00	.....	.....	.....	105.00	105.00	16.56	20.16
	115.00	*115.00*	*105/108*	*105/108*	*110.00*	*110.00*	*120/125*	*135.00*	*135.00*	.....	.....	.....	.....
Los Angeles	*104.00*	*104.00*	*103.00*	*103.00*	*103.00*	*103.00*	*111.00*	*120.00*	*110.00*	.....	.....	13.38[g]	16.26[g]
Minneapolis	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.56	20.16
	111.00	*111.00*	*111.00*	*111.00*	*111.00*	*118.00*	.....	.....	.....	.....	.....	.....	.....
Montreal	75.00	76.00	75.00	75.00	76.00	85.00	.....	.....	.....	.....	.....	.....	.....
	155.00	*155.00*	*155.00*	*155.00*	*155.00*	*155.00*	.....	*150.00*	.....	.....	.....	.....	.....
New Orleans	80.00	90.00	75.00	80.00	80.00	77.00	85.00	.....	.....	100.00	105.00	18.72	22.80
	68.00	*68.00*	*70.00*	*67.00*	*67.00*	*67.00*	*71.00*	*67.00*	*78.00*	.....	.....	.....	.....
New York	95/100	95/100	Range from $87.50 to $95.00				110/115	.....	.....	175/200†	175/200†	22.86	27.90
	.....	.....	*Range from $105.00 to $110.00*				*105/110*	*130/135*	*130/135*	.....	.....	.....	.....
Philadelphia	Range from $100.00 to $110.00						100/110	.....	.....	180.00	180.00	22.86	27.90
	Range from $110.00 to $120.00						*110/120*	*127.00*	*127.00*	.....	.....	.....	.....
Pittsburgh	78.00	79.00	82.00	84.10	89.25	93.70	112.00	.....	.....	130.20	141.00	22.56	27.48
	103.60	*103.60*	*105.60*	*105.00*	*109.00*	*129.75*	*122.00*	*150.00*	*166.00*	.....	.....	.....	.....
St. Louis	95.00	98.50	87.50[m]	92.50[m]	99.50[m]	107.00[m]	.....	.....	.....	.....	.....	18.72	22.80
	.....	.....	*115.00[n]*	*115.00[n]*	*115.00[n]*	*115.00[n]*	.....	.....	.....	.....	.....	.....	.....
San Francisco	*79.00*	*79.00*	*79.00*	*77.00*	*77.00*	*75.00*	*75.00*	*75.00*	*75.00*	.....	.....	10.08[g]	12.30[g]
Seattle	*70.00[i]*	*70.00[i]*	*70.00[i]*	*70.00[i]*	*70.00[i]*	*70.00[i]*	*75.00[i]*	*75.00[i]*	*75.00[i]*	.....	.....	.....	.....

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Spruce. [2] Western Pine No. 3 Common. ‡ Delivered. *a* Yard prices. *b* Retail prices, less than CL. *c* 5 M ft. or less. *d* Direct mill prices; f.o.b. purchasers carrier or truck. *e* Tax exempt. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* No. 1 common. *j* Delivered in 5000 ft. lots. *k* These are retail yard prices quoted per truck load in Greater Cleveland. Less 2% for cash. Truck lots. *l* F.o.b. mill. *m* 8 to 12 ft. lengths. *n* 8 to 16 ft. lengths.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ¼", $188.00; on ¾", $218.00. For other centers add rail freight increment from table on proper size. Oiling and edge sealing charges included.

† 18 ft. and under.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Jan. 16, 1946*a* — Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*	
	A quality	B quality		
Atlanta	76%	76%	$0.2025	
Baltimore	70–10%	71–10%	.2025	
Birmingham	68%	68%	.1575	
Boston	.....	60%*i*	.2025	
Chicago	64%	64%	.2025	
Cincinnati	67–6%*e*	67–6%*e*	.2025	
Cleveland	62–10–10%	62–10–10–10%	.2425	
Dallas	65%	65%	.215	
Denver	66%	66%	.2075	
Detroit	62–10–10%	62–10–10%	.2025	
Kansas City	65–10%*e*	65–10%*e*	.2075	
Los Angeles	58%	63%*f*	.21	
Minneapolis	64%	64%	.2075	
Montreal	40–5%*bc*	40–10–5%*bc*	18.90*h*	
New Orleans	68%	68%	.2125	
New York	71%	72%	.32*g*	
Philadelphia	69%	70%	.2025	
Pittsburgh	70%	70%	.175	
St. Louis	70–10%	70–10%	.2075	
San Francisco	66%	73%	.2075	
Seattle	57%	58%	.21	

Price of 60% Ammonia Gelatin is $0.0125 per lb. higher than 40%

Glass: *a* Jobbers' list price per box, 14 x 20, ss, $20.75 for A quality, $18.00 for B quality; 14 x 20, ds, $30.75 for A quality, $26.00 for B quality. *b* Discount from list, Sept. 1939; sales tax included, but 6% tax exemption not allowable for. *c* Single thickness. *e* Discount from list of Aug. 15, 1938. *f* ss; ds—62%. *i* Double thickness 65%.

Explosives: * Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas. *g* In borough of Kings, Queens, and Richmond and in Manhattan south of Canal St., add delivery charge of $9.00 per trip. *h* F.o.b. city per 100 lb. forcite, 40%. Forcite 60%, $20.65.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.155	$0.1825	$0.2025
W. of Miss. to Rocky Mtn. States, Fla. and Maine	.16 –.1675	.1875–.20	.2075–.22
Rocky Mtn. States	.16 –.1725	.1875–.20	.2075–.225
Pacific N. W. States	.1575–.17	.19 –.2025	.21 –.2225
Pacific S. W. States	.155 –.1625	.1875–.195	.2075–.2175

PILES, TIES F. O. B.

PILES

Prices per linear foot, fir and pine, bark on. f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail — Pine*	By Rail — Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	....
12-in.— 2-ft. from butt	6-in	50 to 59-ft.	.37	....
12-in.— 2-ft. from butt	6-in.	60 to 69-ft.	.39	....
12-in.— 2-ft. from butt	6-in.	90 to 100-ft.	....	72
13-in.— 3-ft. from butt	5-in.	91 to 100-ft.	....	.73
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.43	80
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.47	.74
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.60	75
14-in.— 2-ft. from butt	5-in.	85 to 89-ft.	....	.76
14-in.— 2-ft. from butt	5-in.	90 to 100-ft.	....	.80

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak[i]	....	.....	....	.....
	Pine[i]	....	.....	....	.....
New York	S. L. Sap Pine	$1.65	$2.85	$2.00	$3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.55/2.60*a*	....	3.25/3.40*a*
Los Angeles	Douglas Fir	1.86	3.25*a*		....
Philadelphia	Red Oak	2.33	3 13	3 10	4.25*a*
St. Louis	White Oak	2.40		3.07	....
	Red Oak	2.29	2.95*a*	2.97	3.90*a*
	Sap Pine or Cypress	3.07*a*	....	....	....
San Francisco	Douglas Fir	1.60*e*	2.80*f*	2.10*f*	3.88*e*/*f*
Montreal	Birch or Maple	....*h*	....*h*	....*h*	....*h*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 7' x 9' x 8'. *e* Empty cell. *e* Green. *f* F.o.b. cars. *h* No constant price available. *i* Not available

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100 lb.	$4.25
Chlorine cylinders, liquid, per lb. f.o.b. works	.07–.12
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, f.o.b. works, ton	22.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.80
Soda ash, 58%, in paper bags, per 100 lb. dense	1.50
Sulphate of aluminum, commercial, in 100-lb. bags f.o.b. works	1.50
Sulphate of copper, in bags, per 100 lb f.o.b. works	8.10

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME — DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over, 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity Common backing	Straight hard	LIME Per ton, Hydrated finishing	In paper, Carload lot, Common hydrated	Pulverized, or lump
Atlanta	.....	.....	.....	.....	.....	.....	$25.00	$25.00	$19.00	$17.50	$17.50
Baltimore	$120.00	$126.00	$220.00	$240.00	$315.00	$340.00	31.00*k*	33.00*k*	30.18	18.00	....
Birmingham	97.50	104.00	195.00	231.00	.....	.....	20.00*ff*	22.50*gg*	24.67	18.10	.....
Boston	145.65†	155.35†	291.30†	330.15†	.....	.....	32.00*i*	35.00*i*	30.80†	26.40†	.....
Chicago	115.00	122.50	230.00	.....	.....	.....	21.00	23.00	25.50	19.50	.....
Cincinnati	155.00*j*	165.00*j*	220.00*jdd*	.....	.....	.....	34.00*j*	34.00*j*	19.50*j*	21.20*j*	.....
Cleveland	118.00*cc*	126.00*cc*	236.00*cc*	.....	.....	.....	28.50	28.50	24.00	22.00	27.50*ee*
Dallas	.....	110.00	.....	.....	.....	.....	18.75	33.25	28.00	22.00	.....
Denver	.....	.....	.....	.....	.....	.....	30.00	30.00	34.80*bb*	28.00*bb*	34.00*bb*
Detroit	117.08	124.88	234.15	234.15	290.66	332.20	30.00*cc*	31.50*cc*	30.00	28.00	28.00
Kansas City	112.00	120.00	... ..	.....	.....	.....	16.00*o*	18.50*o*	36.00*p*	30.00*p*	30.00*p*
Los Angeles	*r*	*r*	*r*	*r*	*r*	*r*	20.00§	.....	.....	36.00	35.00
Minneapolis	152.00*p*	176.00*p*	317.00*p*	176.00*wp*	.....	.....	30.00*rp*	.....	34.50*bbe*	25.50*bbe*	34.50*bbde*
Montreal	110.00*aq*	120.00*aq*	225.00*aq*	.....	.....	.....	25.50	37.00	12.50*ub*	14.00*ub*	.....
New Orleans	160.00	160.00	300.00	.....	.....	.....	29.00	.....	38.00	26.00	37.50
New York	112.20*h*	119.60*h*	164.50*h*	179.40*hn*	.....	.....	33.50	...	34.40	27.00	....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	27.00	30.00	29.75	17.50	24.50
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.60	26.00	38.00*y*	20.45	18.65	2.97*m*
St. Louis	119.00	130.00	235.00	235.00	320.00	.....	30.50*sl*	28.50*sl*	.80*aaap*	.60*aaap*	1.00*aaaper*
San Francisco	132.00*a*	148.50*a*	198.00*dda*	148.50*ta*	.....	.....	30.00	.....	24.95	24.95	2.49*m*
Seattle	150.00*cc*	160.00*cc*	.....	160.00*ccw*	.....	.....	32.00	39.00	32.00*hhh*	32.00*hhh*	3.60*mhh*

† F.o.b. *a* Smooth. *b* Per 50 lb. bags. *c* 6 x 12 x 12 in.-3 cell. *d* Pulverized hot. *e* 5% discount for cash. *g* 5½ x 8 x 12. *h* F.o.b. trucks, job site N.Y.C. *i* F.o.b. warehouse only. *j* Truck load or over. *k* $1.00 discount. *l* Red face. *m* Per bbl., 180 lb. *n* 7½ x 7½ x 12. Speed tile. *o* F.o.b. Buffalo. *p* Truck lots. *q* Provincial and Municipal tax extra. *r* Not used because of earthquake danger. *s* 2% discount for cash. *t* 5½ x 8 x 11½. *u* Tax exempt. *v* Sand lime. *w* 5 x 8 x 12. *y* Stacked. *z* Pebble lime price per 80 lb. sack. *aa* Price per sack. Lime not sold per ton. *bb* LCL. *cc* Truck delivery. *dd* 6 x 12 x 12. *ee* Pebble lime. *ff* 80% common. *gg* Select. *hh* LCL. § F.o.b. plant.

PAINT, ROOFING — F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in 100 lb. cases In oil *w*	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85-90 lb. per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$23.60	$31.375	$1.75	$2.70	$1.65	$2.06‡	$2.06‡	$2.06‡	$1.00‡	$36.00‡
Baltimore	23.35	31.00	2.25	3.50	2.75	2.75	3.30	3.30	.55	34.00
Birmingham	23.60	31.375	4.40	4.52	....	3.05	3.00	3.00	.48	42.00*ee*
Boston	23.35	31.00	....	.. ..	....	....	....	2.75‡*q*	....	34.00
Chicago	23.35	31.00	....	....	....	2.82‡*u*	2.87‡*o*	2.87‡*o*	35.00‡*bbn*	38.00†
Cincinnati	23.35	31.00	....	....	....	2.44‡	2.54‡	2.54‡	.35*y*‡	40.00‡
Cleveland	23.35	31.00	3.00	3.00*s*	3.00	2.44	2.54*o*	2.54*o*	.32*y*	38.00
Dallas	23.35	31.00	....	4.05	....	3.50*q*	3.75*q*	4.35*q*	.30	45.00
Denver	23.35	31.50	2.88	4.38	2.63	3.17*o*	3.10*o*	.....	.41*ff*	48.00
Detroit	23.35	31.00	3.24*	2.72*	3.60*	2.32	2.41	2.41	....	35.00
Kansas City	23.35	31.125	....	....	...	3.25	3.85	....	.55	.....
Los Angeles	23.60	31.50	2.80	4.00	3.50	2.32	1.77*e*	*l*	.65	*l*
Minneapolis	23.35	31.625*m*	....	....	....	2.42*idd*	2.47*hidd*	2.47*hidd*	.42*idd*	35.00*rdd*
Montreal	.....	23.65	3.25*p*	4.20*p*	3.62*p*	3.45*t*	3.15*tf*	2.65*tf*	...	2.60*kt*
New York	23.35	31.00	3.45*y*	....	3.45*y*	2.32	2.41*o*	2.41*o*	.34*s*	35.00
Philadelphia	23.35	31.00	3.25	3.65	3.15	2.54	2.94	2.94	.37	26.00
Pittsburgh	23.35	31.00*f*	2.00	2.40	1.90	3.00	3.10*o*	3.10*o*	.37	40.00
St. Louis	23.35	31.00	...	....	....	2.22	2.42*h*	2.42*h*	.40	36.00
San Francisco	23.60	31.25	1.80	2.75*n*	1.35	2.27*x*	3.30*aa*	....	.38*g*	.....
Seattle	23.60	31.50	2.95*m*	2.95*m*	....	3.25*mqcc*	3.35*hmcc*	....	.49*mcc*	46.75*jmcc*

‡ Delivered. Note: Red lead in oil 50c higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* 15 lb. *f* Per 432 sq. ft. *g* 50 gal. drums. *h* Per roll. 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per cwt. *l* Not used. *m* 1% discount for cash. *n* May, 1941 price. *o* Per 60-lb. roll. *p* Tax included. *q* Per 90-lb. roll. *r* F.o.b. factory Chicago. *s* ASTM Spec. D266-41. *t* Federal tax included. *u* Per 90 lb. square. *v* Per ton. *w* Price to large paint contractors is $1.25 less. *x* Mineral surfaced. *y* 55-gallon container. *z* Drums. *aa* Approximate cost per 100 lbs. *bb* Roofers coating and cement. Price per ton. *cc* LCL, truck delivery. *dd* 2% cash discount. *ee* Asphalt, in 100 lb. package. *ff* 5-gal. drums. * Sept. prices were for LCL.

SKILLED AND COMMON WAGE RATES — PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Electrical Workers	Steamfitters	Common Labor — Building	Common Labor — Heavy Const.
Atlanta	$2.50	$1.775	$2.00	$2.00	$2.00	$2.00	$2.00	$0.85	$0.95
Baltimore	2.50	2.25	2.40	2.20/2.40	2.25	2.25	2.25	1.25	1.25
Birmingham	2.25	1.80	2.15	1.75/2.25	2.20	2.00	2.25	.95	1.05
Boston	2.50	2.10	2.40	2.45	2.50	2.30	2.30	1.55	1.55
Chicago	2.40	2.35	2.40	2.35	2.40	2.35	2.35	1.70	1.70
Cincinnati	2.50	2.20	2.35	2.50	2.375	2.375	2.35	1.46	1.46
Cleveland	2.375	2.325	2.375	2.25	2.375	2.375	2.375	1.725	1.725†
Dallas	2.50	2.25	2.25	2.25	2.125	2.00	2.375	1.075	1.275
Denver	2.25*b*	2.10	2.00*b*	2.15*b*	2.25	2.25	2.24	1.40	1.35
Detroit	2.50	2.20	2.40	2.40	2.50	2.40	2.40	1.575	1.575
Kansas City	2.50	2.05	2.20	2.05/2.275	2.50	2.30	2.375	1.475	1.49
Los Angeles	2.625	2.0375	2.10	1.9875	2.25	2.40	2.50	1.4875	1.4875
Minneapolis	2.25	2.05	2.175	2.00	2.35	2.21	2.25	1.45	1.45
New Orleans	2.05	1.875	2.00	1.625/1.875	1.875	2.00	2.25	90	.90
New York	3.20*b*	2.75*b*	3.00	3.00	3.20*a*	2.50*a*	2.75*b*	1.70	1.70
Philadelphia	2.75	2.25	2.65	2.50	2.50	2.375	2.50	1.25	1.25
Pittsburgh	3.00	2.50	2.50	2.65	2.625	2.375§	2.50	1.50	1.50
St. Louis	2.75	2.45	2.425	2.55	2.50	2.50	2.50	1.50	1.75
San Francisco	2.8125	2.16	2.25	2.125	2.25	2.25	2.25	1.525	1.525
Seattle	2.365	2.065	2.265	2.20	2.365	2.265	2.50	1.665	1.70
Montreal*	1.40	1.25	1.30	1.20	1.40	1.35	1.11	.94	.88

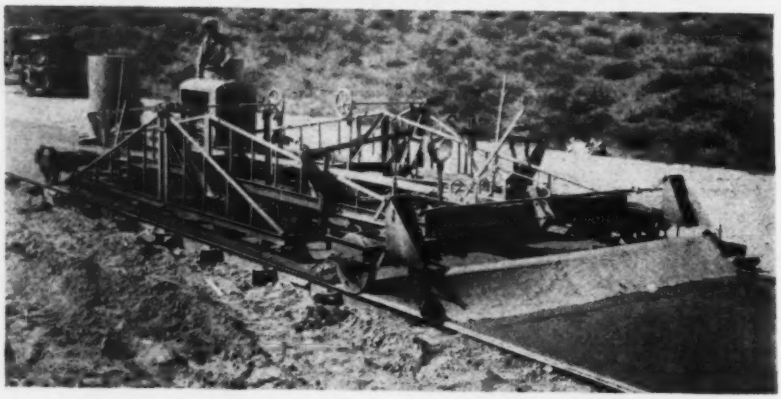
a 6 hr. day. *b* 7 hr. day. * Cost of living bonus now included in basic wage. *Correction:* † July-Sept. rate also $1.725. § Sept. rate, $2.375.

MEXICO CITY PRICES

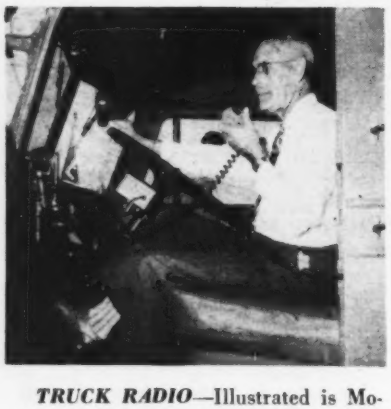
In Pesos, f.o.b. City		Aug. '48	Sept. '48
Common Wages—Building (8 hr. day)	av. per hr.	.57	.57
Common Wages—Heavy Const. (8 hr. day)	av. per hr.	.75	.75
Skilled Labor Wages			
Carpenters (8 hr. day)	av. per hr.	1.25	1.25
Bricklayers (8 hr. day)	av. per hr.	1.25	1.25
Struct. Iron Workers (8 hr. day)	av. per hr.	1.50	1.50
Struct. Steel Shapes 3"-15" x 12 meters	per ton	1,300.00	1,300.00
Reinf. Steel, Corr. Rods			
⅜" x 12 meters	per ton	1,140.00	1,140.00
½" x 12 meters	per ton	1,080.00	1,080.00
⅝" x 12 meters	per ton	1,056.00	1,056.00
¾" x 12 meters	per ton	1,020.00	1,020.00
⅞" x 12 meters	per ton	1,020.00	1,020.00
1" x 12 meters	per ton	1,020.00	1,020.00
Gravel, truck load of 3½ cu. meters			
Blue Gravel	per tr. load	32.00	32.00
Rose Gravel	per tr. load	30.00	30.00
Cement, Std. Port. (Tolteca)	per ton	115.00	115.00
Lumber			
Mex. Sacred Fir (Oyamel)	per M ft.	350.00	350.00
1st Class Pine	per M ft.	700.00	700.00
2nd Class Pine	per M ft.	550.00	500.00

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $2.332. **ENR Common Average:** $1.413

NEW PRODUCTS



FLOAT FINISHER — For several years, the Johnson float finisher, pictured above, has been standard equipment with many western highway contractors. The patents for this machine have been acquired by the Madsen Iron Works and it will be known hereafter as the "Madsen-built" Johnson float finisher.—*Madsen Iron Works, Huntington Park, Calif.*



TRUCK RADIO—Illustrated is Motorola 2-way FM radio equipment installed in the Duplex dumptruck-scraper exhibited during the recent Road Show at Chicago. The unit was in communication with the Motorola booth about three-fourths of a mile across the grounds. Fourteen other similarly equipped vehicles served as a communication network over which much Road Show business was conducted—*Motorola, Inc., 4545 Augusta, Chicago 51, Ill.*

CLAY SEWER PIPE—Clay sewer pipe of high quality is turned out in large volume with a new-type hydraulic press which operates on the low-pressure, large-volume principle. The cost of operation is 40 percent that of steam-operated presses, and based on 8 mills per kwh, the power cost is $2 per 75 tons of product. The press has a 20-in. clay cylinder 36 in. long. The hydraulic cylinder is 19 in. in diameter by 48-in. ram travel. Operating at a normal hydraulic pressure of 750 psi., the pressure on the clay is equal to that of a 44-in. steam cylinder at 140 lb. steam pressure. At 850 lb, it is equal to a 48-in. steam cylinder at 130 lb. Operating pressure is supplied by a Pearne & Lacy 300 g.p.m. rotary vane pump. Driven by V-belts from a 75-hp. motor, the average load over a day's run is approximately 40 hp. The frame is of 10-in. H-beam and 15-in. I-beam construction. The fabricated steel clay cylinder has cast-iron liners. The press requires an overhead tank of 150-gal capacity and a storage tank of about 1,200-gal. capacity. Three methods of feeding clay into the vacuum chamber may be used; the ram-type feeder, feeding from a de-airing auger or combination machine, or the quick-operating door and fast-belt method.—*Pearne & Lacy Machine Co., Los Angeles, Calif.*

INSULATED WIRE—"Laytex RUW" is the name of a new electrical wire with rubber insulation that improves when soaked in water. It is designed for use underground and in wet locations where high moisture resistance gives it longer life and increased safety. It is particularly suitable for underground lead-ins and for wiring damp basements. The secret of the wire's durability is a coating of high purity natural rubber latex applied by the dip process. In addition to greater moisture resistance, the insulation of the new wire has improved tensile strength and elasticity.—*United States Rubber Co., Rockefeller Center, New York, N. Y.*

HEATING CABLE—An inexpensive installation of heating cable will keep an open channel through ice dams which form on roof eaves during severe winter weather. It prevents seepage. The cable is mounted to cover about a 3-ft. strip bordering the eaves with a zig-zag design. Sixty feet of cable will take care of a section of roof 20 to 25 ft. long. Sixty feet of flexible, lead-covered, insulated resistance wire with both ends connected to an ordinary attachment plug are contained in each set. An ordinary weatherproof convenience outlet can be installed on the outside of the house to furnish the 110 volts required for the cable.—*General Electric Co., Schenectady, N. Y.*

SNOW PLOW—V-type hydraulically operated snow plow and a 2-cu. yd. snow bucket have been added to accessories for Allis-Chalmers HD-5 crawler tractor. Dimensions of plow are: width at ground, 116 in.; width at top, 128 in.; height of V in front is 44 in. and in rear 66 in. Snow bucket is 96 in. wide and has a 2-cu. yd. capacity. Both units are sold exclusively by Allis-Chalmers dealer organizations. Both plow and snow bucket are manufactured by Tractomotive Corp., Deerfield, Ill.—*Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis.*

SCOOTER LOADER — Doing the work of four men with wheelbarrows, an inexpensive front-end loader has an 8-cu. ft. or 1,200-lb. capacity with 4½-ft. clearance for loading dump carts as well as mixer skips. Caster-type rear wheel enables the loader to turn in its own length. Drive is to the front wheels, and the transmission provides four forward speeds up to 15 mph. plus one reverse speed. Other features include traction-grip pneumatic tires and a 9-hp. air-cooled engine.—*Arrow Contractor Equipment Co., 2020 Walnut St., Chicago 12, Ill.*

REVOLVING SCOOP—Full-revolving, cable-crowding scoop is designed to clean corners, load gravel, coal, earth, aggregate or snow. Operates from all angles. Available as standard attachment for Model E and Model J Quick-Way truck shovels. Scoop is available in capacities of ⅜ and ⅝ cu. yd. Model E has dumping radius of 6 ft. 11 in. to 16 ft. 7 in., dumping height of 3 ft. 7 in. to 16 ft. 6 in. and digging radius of

In the large, modern sewage treatment plant, constructed at Norfolk, Va. by the Hampton Roads Sanitation District Commission, definite steps were taken to forestall corrosion attack by installing Byers Wrought Iron pipe in vital services. Digester coils are 3-inch extra-heavy black wrought iron pipe. Heating supply and return lines in buildings are standard weight black wrought iron pipe in ½ to 3-inch sizes. Wrought iron pipe is also used in plant water lines and chlorine lines. Aldrich and Buck were the Consulting Engineers on the project.

PROVEN PROTECTION

The wide-spread use of wrought iron in the most corrosive services in sewage treatment plants is based on the proven durability of the material. A good example is provided by sludge digestion tanks, where the naturally aggressive character of the sewage is multiplied by heating. In one reported instance, the stirring mechanism was built originally of low-first-cost materials—and failed in only a year. The mechanism was replaced, using wrought iron. At last report, the wrought iron had served for over seven years . . . with no trouble.

UNIQUE QUALITIES

Wrought iron is different in composition and structure from any other material. Tiny threads of glass-like silicate slag, distributed through the body of high purity iron, halt and "detour" corrosive attack. They also help to anchor the initial protective scale, which shields the underlying metal.

There are a number of services in the average plant where only the most durable material is justified. Digester coils, stirring mechanism, gas lines, vent stacks, air lines—every one of these, as well as others, represents a "hot spot". Our bulletin, "Wrought Iron for sewage treatment and disposal installation" discusses the application of wrought iron to curb early failures and excessive maintenance, and will help you in planning new plants, and maintaining existing installations. Ask for a copy.

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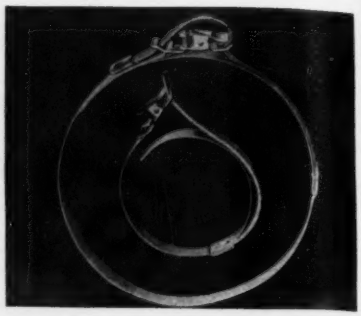
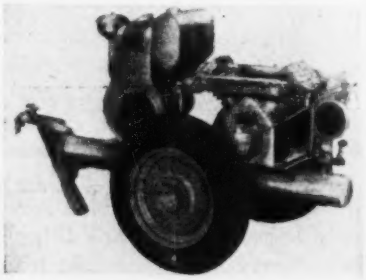
14 ft. 4 in. to 19 ft. 5 in. Model J ranges are: dumping radius, 6 ft. 1 in. to 15 ft. 4 in.; dumping height, 2 ft. 9 in. to 14 ft. 5 in.; digging radius, 12 ft. 6 in. to 17 ft. 6 in. Scoop is interchangeable with other attachments.—*Quick-Way Truck Shovel Co., Denver 5, Colo.*



FLEXIBLE CONDUIT CLAMP—Flexfast is a low pressure clamp for use with flexible conduits. Provides fast, positive clamping action over diameters from 1½ to 37 in., each size having a wide range of take-up. Requires no tools, for quick and easy set-up or release. Combines an overlapping one-piece, non-rusting nickel clamping band with a strap and buckle take-up. Constructed of only three parts, permanently integrated into single unit.—*Flexible Tubing Corp., Branford, Conn.*



COMPACT COMPRESSOR—Pac-Air is a self-contained, completely air-cooled, gasoline-engine-driven portable compressor unit for small building contractors, or as a utility compressor for large contractors. The 2-cylinder, single-stage compressor has a piston displacement of 37.5 cfm at 80 psi pressure. Some uses are drilling anchor bolt holes, chipping, roughing concrete for patching, tearing out brick and masonry, installing machinery, and breaking up small boulders.—*Ingersoll-Rand, 11 Broadway, New York 4, N. Y.*

LEAF AND LITTER COLLECTOR—A new leaf and litter collecting unit is available to municipalities. It has such features as an hydraulic jack under the trailer tongue to facilitate hitching and one under the dump body to dump the load in one minute; a vacuum snout on

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Fast-Strong-Mobile-Economical

MAKE SIMPLE WORK OF THE TRENCHING JOBS FOR:

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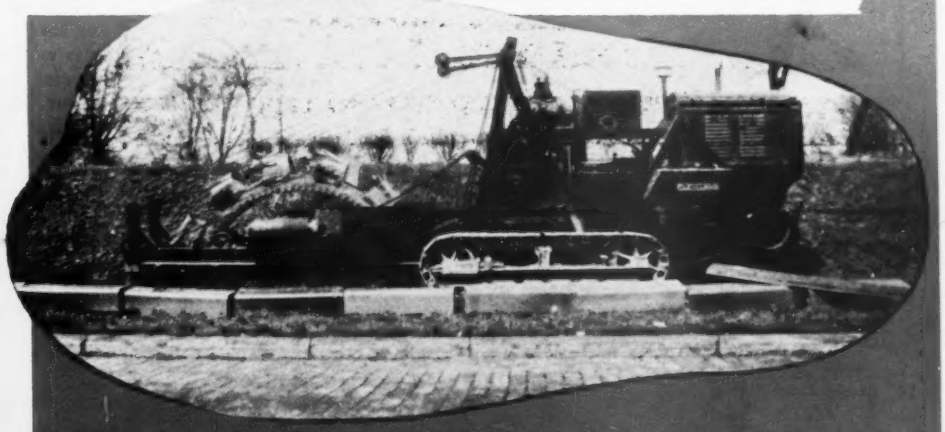

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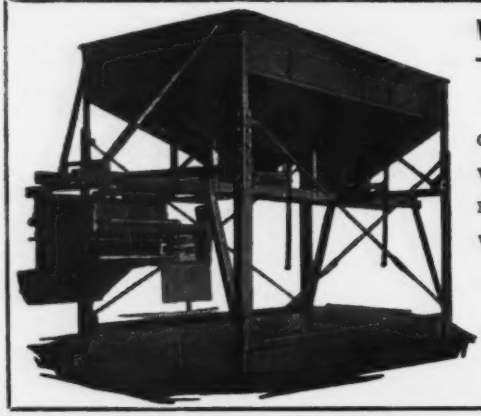

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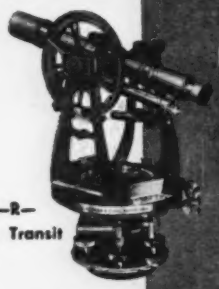

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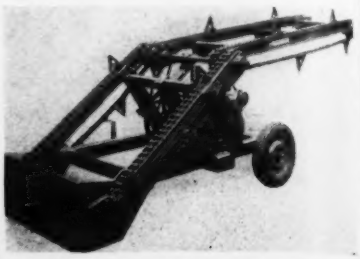
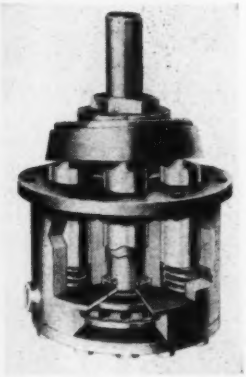
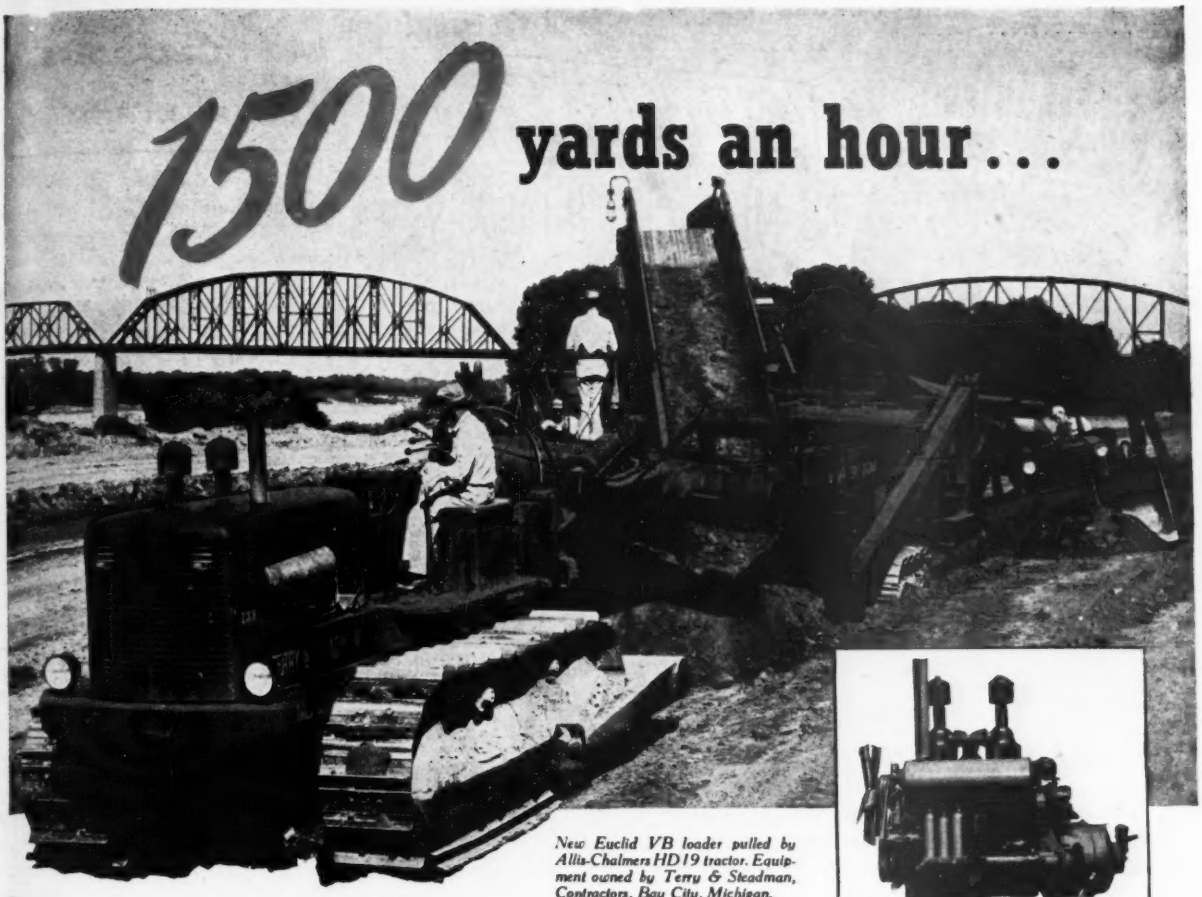


LOG LOADER—A loader designed for loading, stacking and otherwise handling 8-ft. logs has been introduced under the trade name of Triad Special **Loader by Northwest Machine** Works, Portland, Ore. The original model was designed for Rayonier, Inc., New York, operators of pulp mills in the Pacific northwest and Florida. The device is of steel construction, center balanced on steel axle with standard heavy duty wheels and pneumatic tires for mobile operation. The elevator section operated by a pneumatic hoist attains a maximum height of 12 ft. for stacking or loading. It is powered by its own gas engine with chain drive and built-in clutch and gear reduction. The conveyor is spaced with 8-in. grousers. The machine has an overall length of 17½ ft. and weighs 3,500 lbs.—*Northwest Machine Works, Portland, Ore.*



HYDRAULIC PUMP—With a rotating plate for reciprocating the pistons without any side thrust a piston type hydraulic pump with rotary valve operates in either direction with one adjustment. The rotary valve is full floating and hydraulically balanced. The Dudley Pump is manufactured in all capacities commonly used for hydraulic systems.—*Cannon & Co., 2320 E. 8th St., Los Angeles 21, Calif.*

1500 yards an hour...



New Euclid VB loader pulled by Allis-Chalmers HD 19 tractor. Equipment owned by Terry & Steadman, Contractors, Bay City, Michigan.

General Motors Series 71 Diesel Engine as adapted by Allis-Chalmers for the HD 19 tractor.

24 hours a day

WHEN this Euclid VB loader and Allis-Chalmers HD 19 tractor went to work on the Louisville, Kentucky levee project, the dirt really began to fly—1500 cubic yards an hour, 24 hours a day.

"Almost double the amount other types of equipment move," the superintendent tells us. And no wonder! For the HD 19 boasts a wealth of smooth, dependable General Motors Diesel power.

Because the GM Diesel engine operates on the 2-cycle principle, it provides power at every downstroke. So the "six" performs like a "twelve"—turning out more work and sticking to it longer.

Whatever your need for power may be, it will pay you well to standardize on General Motors Series 71 Diesels. Not only are they frugal with fuel, but these engines are long-lived, durable workers that are easy to maintain. And you get an added bonus of parts interchangeability between engines of different sizes. See your local dealer, or write directly for further details.

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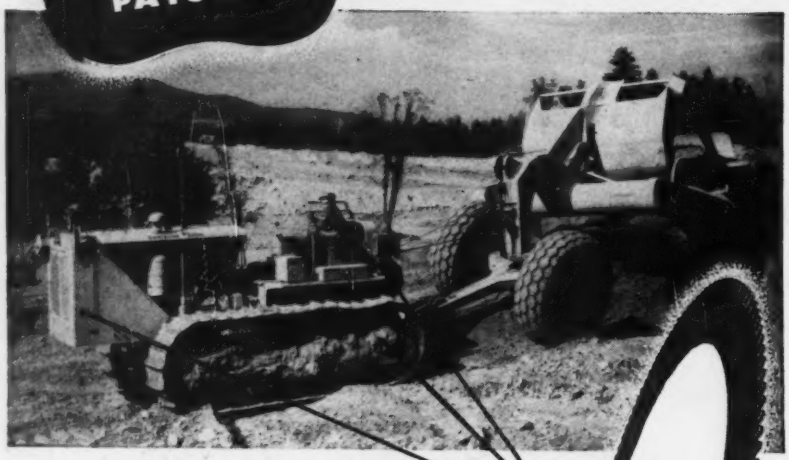

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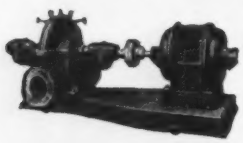

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Manufacturers' Publications

Batching Equipment—Six bulletins describe a complete line of batching equipment ranging from a 1¼-cu. yd. aggregate type to a 6-cu. yd. combination cement-and-aggregate unit. They are used with bins rated from 30 to 400 tons aggregate capacity and from 100 to 1,500 bbl. cement capacity.—*The Heltzel Steel Form & Iron Co., Warren, Ohio*

New Industrial Drills—A 2-color circular features the new Fairchild ¼-in. drill and the Hi-Power ½-in. model. It is said that the latter is the first industrial type ½-in. drill to sell for under $30.—*Precision Equipment Co., 2658 N. Long Avenue, Chicago 39, Ill.*

Light-Weight Air Hose—A four-page broadside on a light-weight air hose for small pneumatic tools pictures and describes a new air hose, which is as flexible as a lamp cord and has many uses. —*The B. F. Goodrich Co., Akron, Ohio.*

Metal Buildings—"More for your Building Dollar" is the title of a six-page folder describing and illustrating the uses of Standard ARMCO STEELOX buildings. Included are general data showing range of sizes, types of doors and windows, partitions, ceilings, louvres and ridge ventilators. The folder describes the specific applications for which the buildings may be used.—*Armco Drainage & Metal Products, Inc., Middletown, Ohio.*

Plumbing and Drainage—A new 80-page Wade catalog of sealed air chambers, grease interceptors and drainage and plumbing specialties has three unique features: Selector tables for determining roof leader sizes; tabulated information on the correction of destructive fluid pressure surges, commonly called "water hammer"; and tables for the correct sizing of grease interceptors. —*Wade Mfg. Co., Elgin, Ill.*

Zoned Equipment—The combination of application of tracks and rubber for successful earthmoving is the subject of a recently published booklet of 12 pages. It is indicated that there are these three work zones in this field, viz., clearing, pioneering, heavy dozing and pusher-loader; slow speed hauling over rough terrain; and high average haul and return speeds where good roads for long hauls are encountered. — *Caterpillar Tractor Co., Peoria 8, Ill.*

STANDARD ENGINEER'S REPORT

RPM CALOL

TEST DATA

UNIT 6 cyl. gas Truck + Bus Engine

LUBRICANT RPM Heavy Duty Motor Oil

FUEL Chevron Gasoline

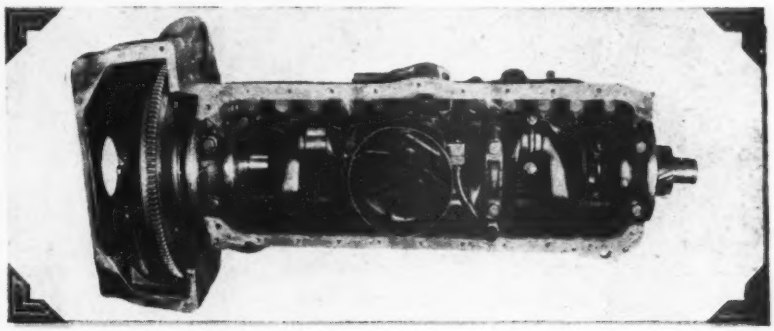
CONDITIONS max. engine loads for prolonged periods

FIRM Mountain Auto Line

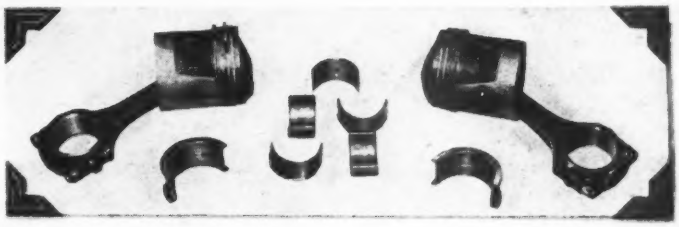
LOCATION San Bernardino, Calif.

TOUGHEST MOUNTAIN SERVICE PROVES RPM HEAVY DUTY KEEPS TRUCK AND BUS ENGINES CLEAN

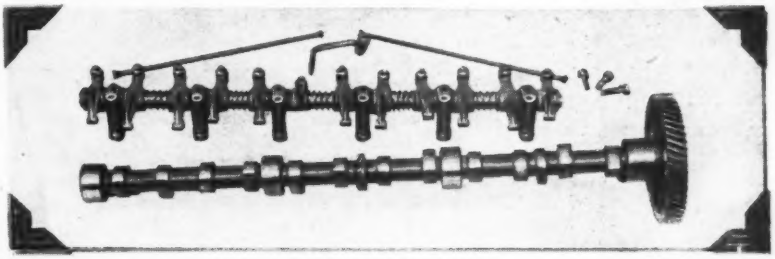
When this engine was pulled out of service for inspection, and the photographs were taken, it had operated on RPM Heavy Duty Motor Oil continuously for 45,000 miles—in service that is about as hard on equipment as any in the country. It is one of 21 units used on a mountain bus and freight run. They climb to a 5000-foot altitude in 15 miles without a stop. Even with 6-bladed fans, pressure-lubricated timing gears and 10-speed transmissions, crankcase temperatures soar above 240 degrees F.



As the pictures at right and above show, the crankshaft, bearings, pistons and rings from the engine were exceptionally clean. RPM Heavy Duty Motor Oil withstands the highest operating temperatures . . . sticks to the hot spots ordinary oils leave bare.



The camshaft was free from lacquer. Pushrods, timing gears and other parts showed minimum wear. RPM Heavy Duty Motor Oil resists oxidation, cleans engines of lacquer and maintains a tough lubricating film. It does this because of inherent properties of its selected base stocks and special compounds.



REMARKS: Many oils, competitive to RPM Heavy Duty Motor Oil, have been tested by Mountain Auto Line in their regular service. Tests have been made in all seasons of the year with atmospheric temperatures ranging from zero to 100°F. above zero in the shade. RPM Heavy Duty Motor Oil is the only oil used that meets every requirement of their engines and prevents clogging with lacquer.

STANDARD TECHNICAL SERVICE conducted and reported this test: If you have a lubrication or fuel problem, your Standard Fuel and Lubricant Engineer or Representative will give you expert help; or write Standard of California, 225 Bush Street, San Francisco 20.

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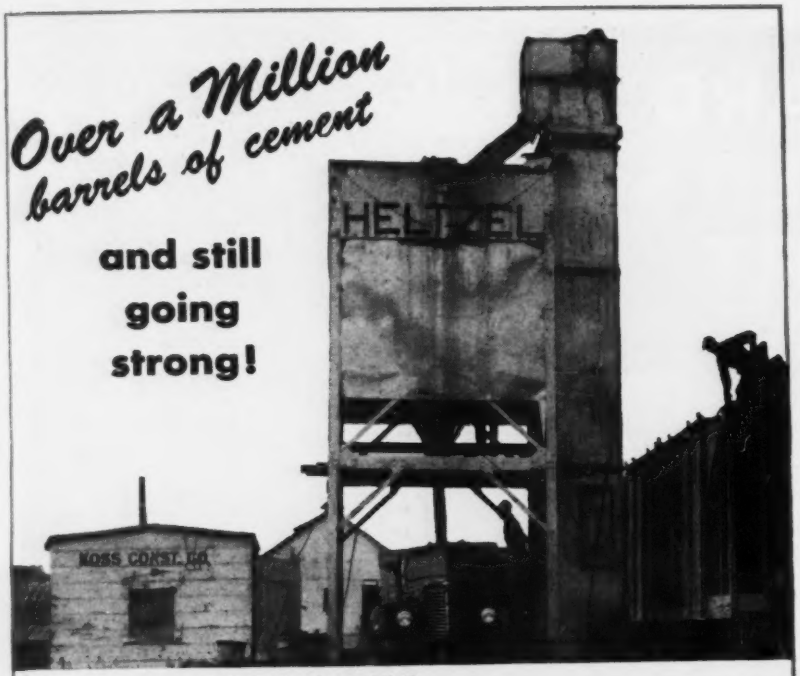


VETERAN **HELTZEL** PLANT HAS REPAID ITS COST 42 TIMES OVER IN 17 YEARS . . .

• 1,160,500 barrels of cement have been unloaded by this plant. In 1931, time studies indicated the plant cost would be repaid at the handling of 25,000 to 30,000 barrels. (Note comments by Mr. Koss in the following letter.)

KOSS CONSTRUCTION CO.
General Contractors Since 1914
FARM BUREAU BUILDING
DES MOINES 8, IOWA

April 21, 1948

Mr. Donald T. Heltzel
Heltzel Steel Form and Iron Co.
Warren, Ohio

Dear Sir:

Our records indicate this bin was purchased by us in 1931. It has been used by us on paving projects all over the middle-west from that time until the present and is still a good plant and doing a fine job. During this period, we have unloaded 1,160,500 barrels of cement with the Heltzel, including box cars, hopper bottoms and truck delivery. You can be justifiably proud of the performance of this equipment.

Yours very truly,

RBK:m

Richard B. Koss
Vice President

CONCRETE BUCKETS

Heltzel plants are products of specialized engineering, and constructed for lasting, trouble-free service. Your requirements for plants will be served best by Heltzel. Write for information and literature.

HELTZEL STEEL FORM & IRON CO. WARREN, OHIO · U S A

New Engineering Books

(*Continued from page* 116)

INTRODUCTION TO APPLIED MATHEMATICS—By Francis D. Murnaghan. 389 pp. John Wiley & Sons, New York 16. Chapman & Hall, London. $5.

ENGINEERING MATERIALS—By Alfred H. White. Second Edition. 686 pp. McGraw-Hill Book Co., New York 18, and London. $6.

INTRODUCTION TO HIGHWAY ENGINEERING—Fifth Edition—By John H. Bateman. 538 pp. John Wiley & Sons, New York 16. Chapman & Hall, London. $5.50.

RAINFALL AND RUNOFF—By E. E. Foster. 487 pp. The Macmillan Co., New York. $9.

NATURAL TANGENTS TO EIGHT DECIMAL PLACES—For Every Second of Arc from 0 to 90 deg. 630 pp. Parker & Co., Los Angeles 13, Calif. $15.

Reports and Pamphlets

EXPERIENCE IN ILLINOIS WITH JOINTS IN CONCRETE PAVEMENTS—ENGINEERING EXPERIMENT STATION BULLETIN SERIES NO. 365. 360 pp. University of Illinois, Urbana, Ill. $1.

TRAFFIC SPEED ENFORCEMENT POLICIES—By W. S. Smith and C. S. LeCraw, Jr. 90 pp. The Eno Foundation for Highway Traffic Control, Saugatuck, Conn.

PROCEEDINGS OF THE SECOND SHORT COURSE AND CONFERENCE AIRPORT MANAGEMENT AND PLANNING—Bulletin No. 104—Texas Engineering Experiment Station, Agricultural and Mechanical College of Texas.

URBAN TRANSPORTATION—By Committee on Urban Transportation. 29 pp. Transportation and Communication Department, Chamber of Commerce of The United States, Washington 6, D. C.

THE ZUIDERZEE WORKS—Ministry of Reconstruction and Housing, The Hague, Holland.

THE FRACTURE OF METALS—By M. Gensamer, E. Saibel, J. T. Ransom and R. E. Lowrie. 84 pp. American Welding Society, 33 West 39th Street, New York 18, N. Y. $1.

NATIONAL SAND AND GRAVEL ASSOCIATION YEAR BOOK, 1948—Washington 4, D. C.

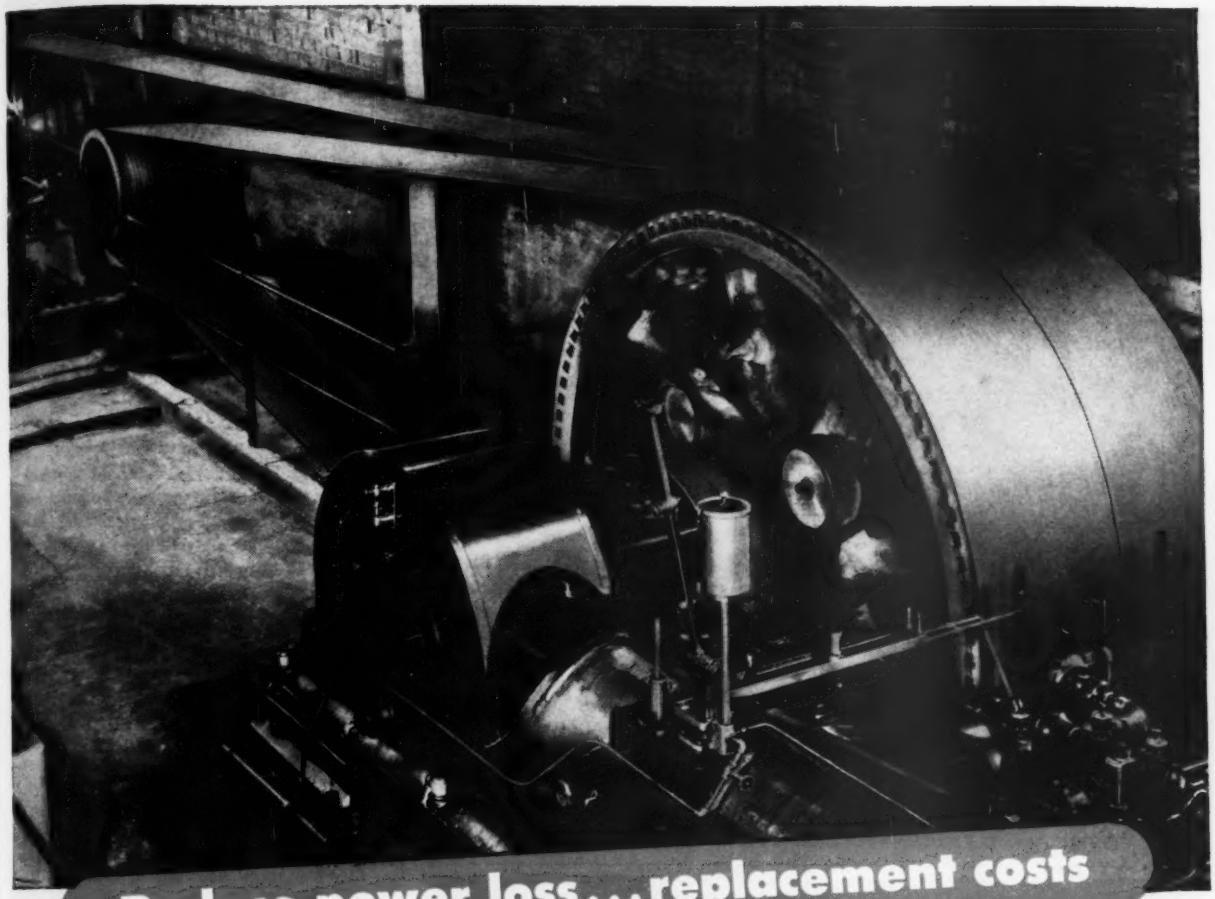
NATIONAL READY MIXED CONCRETE ASSOCIATION YEAR BOOK 1948—Washington 4.

COMPACTION OF SOILS—Technical Bulletin No. 120—American Road Builders' Association, Washington 4, D. C.

THE STATES NEED TO PARTICIPATE IN THE FEDERAL AIRPORT ACT—Technical Bulletin No. 132—American Road Builders' Association, Washington 4, D. C.

FIFTY YEARS OF BUILDING PROGRESS 1898–1948, Dawson Brothers Construction Company, Syracuse, New York.

CEMENTS AND CONCRETE—Office of Technical Service, United States Department of Commerce, Washington 25, D. C.



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Yes, you *save* on power costs when you use Hewitt's Monarch Amber Transmission Belting.

You won't waste power through belt slippage. And you can depend on the belt for full power even when operating at peak capacity.

This famous, extra high quality belting is made by Hewitt to assure maximum power delivery from drive pulley to driven pulley. You will find that it is especially adaptable for your power transmission operations where severe flexing—due to small pulleys, high speeds, and short centers—is encountered.

Monarch straight-edge Amber Transmission Belting is made of only premium-grade, hard (silver) duck. All plies are embedded—completely insulated with highest quality pure gum rubber compounds—to give you the advantages of greater freedom from stretch. It resists moisture, mildew, grit.

For maximum performance use Monarch Amber Transmission Belting wherever there are heavy shock loads or abuse conditions—in pulp and paper mills, saw mills, mines, stone crushing plants, oil fields, quarries, and other severe transmission operations.

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Transmission Belting

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2. All plies straight-laid under uniform tension to insure even stresses throughout the belting.

3. Remarkably flexible and free from stretch because plies are completely insulated with pure gum rubber compounds.

4. No folds, no seams—due to straight-edge construction. Doubles traction life—makes possible use of either side.

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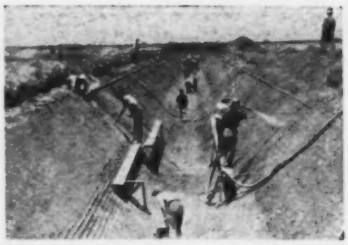

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GUIDE FOR FEDERAL-AID AIRPORT SPONSORS—By W. R. Macatee. Bulletin No. 136. American Road Builders' Association, 1319 F. St., N. W., Washington 4, D. C. $1.

A LABORATORY DEVELOPMENT OF CAVITATION-FREE BAFFLE PIERS BLUESTONE DAM, NEW RIVER WEST VIRGINIA—Technical Memorandum No. 2-243—Waterways Experiment Station, Vicksburg, Miss. $2.

MODEL STUDY OF WAVE AND SURGE ACTION, NAVAL OPERATING BASE, TERMINAL ISLAND, SAN PEDRO, CALIF.—Technical Memorandum No. 2-237, Waterways Experiment Station, Vicksburg, Miss. $1.

MANUAL ON WOOD CONSTRUCTION FOR PREFABRICATED HOUSES—Office of the Housing Expediter and Housing Expediter and Housing and Home Finance Agency. Superintendent of Documents, Washington 25, D. C. $1.50.

MASTER HIGHWAY PLAN FOR THE BOSTON METROPOLITAN AREA—Joint Board for the Metropolitan Master Highway Plan, Boston, Mass.

REPORT ON MASSACHUSETTS STATE HIGHWAY NEEDS EXCLUSIVE OF METROPOLITAN BOSTON—By Massachusetts Department of Public Works, Boston, Mass.

SPECIFICATIONS FOR THE ANNUAL MUNICIPAL REPORT—By Clarence E. Ridley and Herbert A. Simon. The International City Managers' Association, 1313 E. 60th St., Chicago, Ill. $2.

INVESTIGATION OF THE DESIGN AND CONTROL OF ASPHALT PAVING MIXTURES—Three Volumes—Technical Memorandum No. 3-254. Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss. $1.00 each volume.

BUILDING THE NAVY'S BASES IN WORLD WAR II—History of the Bureau of Yards and Docks and the Civil Engineer Corps 1940-1946—Two Volumes. 969 pp. For sale by the Superintendent of Documents, Washington 25, D. C. $7.00 the set.

THE HIWASSEE VALLEY PROJECTS—The Apalachia, Ocoee No. 3, Nottely and Chatuge Projects—Vol. 2. Technical Report No. 5. Tennessee Valley Authority. 783 pp. For sale by the Superintendent of Documents, Washington, D. C. $2.25.

CONCRETE PRODUCTION AND CONTROL—Technical Report No. 21. Tennessee Valley Authority. 352 pp. For sale by the Superintendent of Documents, Washington, D. C. $1.50.

ELEMENTARY AND APPLIED WELDING—By H. P. Rigsby and C. H. Groneman. 151 pp. Bruce Publishing Co., 540 N. Milwaukee St., Milwaukee 1, Wisconsin. $2.

JOURNAL OF THE INDIAN ROADS CONGRESS—No. 3 and 4. 347 pp. Indian Roads Congress, New Delhi, India. 5s each.

Reports and Pamphlets

REPORT OF COMMITTEE ON GRADE SEPARATIONS—RAILWAY AND HIGHWAY—Technical Bulletin No. 133. American Road Builders' Assoc., Washington, D. C.

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b. Flat Bowl Bottom	5		
2. a. Offset Cutting Edge	10	10	
b. Straight Cutting Edge	5		
3. a. Low Center of Gravity	10	10	
b. High Center of Gravity	5		
4. a. Open Top Bowl	10	10	
b. Obstructed Bowl Top	5		
5. a. Weight Distribution 45% front 55% rear	10	10	
b. Weight Distribution Otherwise	5		
Weight empty			
*6. a. Under 5% variation	10	10	
b. 5% to 15% variation	6		
c. Over 15% variation	2		
7. a. Interchangeable Tires—Front & Rear	10	10	
b. Non-interchangeable Tires	5		
8. a. Positive Forced Ejection	10	10	
b. Gravity Dump	5		
**9. a. High Apron Lift	10	10	
b. Medium Apron Lift	7		
c. Low Apron Lift	2		
General Maintenance & Serviceability Characteristics			
10. a. Superior	10	10	
b. Average	6		
c. Inferior	2		
Total	100		

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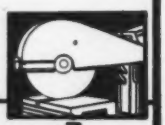
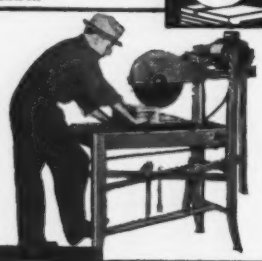
Clipper's exclusive design is guaranteed to provide the highest economy with most rapid cutting speed. With or without foot pedal control.





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TOWARD A GREATER VIRGINIA—Virginia Dept. of Highways, Richmond, Va.

TENTATIVE REPORT OF COMMITTEE ON COST ALLOCATION FOR MULTIPLE PURPOSE WATER PROJECTS—American Society of Civil Engineers, 33 West 39th St., New York City.

TRAFFIC ENGINEERING FUNCTIONS AND ADMINISTRATION—Publication No. 100, Public Administration Service, 1313 E. 60th St., Chicago, Ill. $2.50.

YARDAGE TABLE FOR CIVIL ENGINEERS—By S. Mark, 2125 Logan St., Murphysboro, Ill. $1.

HYDROLOGY OF FIVE ILLINOIS WATER SUPPLY RESERVOIRS—Illinois State Water Survey Bulletin No. 38—Chief, State Water Survey, Urbana, Illinois.

BUCKLING OF TRUSSES AND RIGID FRAMES—Engineering Experiment Station Bulletin No. 36. Cornell University, Ithaca, N. Y. 80c.

THE LEGAL RESPONSIBILITIES OF TRAFFIC AGENCIES—The Eno Foundation for Highway Traffic Control, Saugatuck, Conn.

GERMAN MOTOR ROADS—1946—Road Research Technical Paper No. 8. British Information Service, 30 Rockefeller Plaza, New York 20, N. Y. 55c.

INVESTIGATION OF BRIDGE IMPACTS WITH A MECHANICAL OSCILLATOR—By C. T. West. Engineering Experiment Station Bulletin No. 132. Ohio State University, Columbus, Ohio. 75c.

NATIONAL STANDARDS OF APPRENTICESHIP FOR TERRAZZO WORKERS—U. S. Department of Labor. Copies may be obtained free of charge from the Bureau of Apprenticeship, U. S. Dept. of Labor, Washington 25, D. C.

PROCEEDINGS OF THE 22ND ANNUAL SHORT COURSE IN HIGHWAY ENGINEERING—Agricultural and Mechanical College of Texas —Bulletin No. 105. Texas Engineering Experiment Station, College Station, Texas.

EDUCATIONAL AND INDUSTRIAL PROBLEMS WITH INTERMOLECULAR FORCES—By C. A. P. Turner, 964 N. High Street, Columbus 1, Ohio. $1.50.

RUBBER DEVELOPMENTS—The British Rubber Development Board, Market Buildings, Mark Lane, London E. C. 3, England.

EXTENDING APPLICATION OF THE FINENESS MODULUS—By S. Walker and F. F. Batel. Reprinted from the Journal of American Concrete Institute by the National Sand and Gravel Association, 1325 E. Street, N. W., Washington 4, D. C.

CORRECT APPLICATION OF MOTOR TRUCKS TO THE READY MIXED CONCRETE INDUSTRY—Technical Information Bulletin No. 39. National Ready Mixed Concrete Assoc., 1325 E. Street, N. W., Washington 4, D. C.

APPLICATION OF PLASTIC THEORY TO THE DESIGN OF MODERN REINFORCED CONCRETE STRUCTURES—By C. S. Whitney. Reprinted from the Journal of the Boston Society of Civil Engineers, Boston, Mass.

PROCEEDINGS OF THE 33RD ANNUAL ROAD SCHOOL—Extension Series No. 63—Purdue University, Lafayette, Ind.

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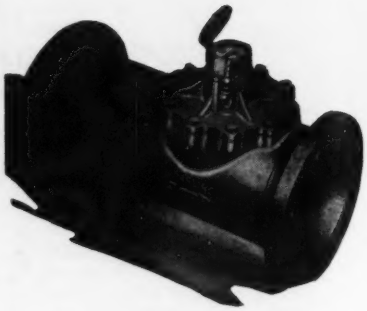
METERS



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Turn to Page 18 for specifications and prices; page 19 for instrument prices, remembering that every Sparling Meter is in itself a complete totalizing unit!

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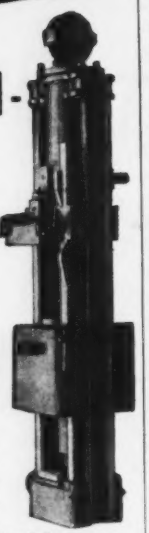

• Like a fighting champion, this rugged pile hammer is always ready for tough ones. It handles wood, steel or concrete piles of any type on job after job, year after year, with a minimum of mechanical difficulty. This proven power and durability assures you speed in pile driving and a saving in maintenance and mechanical costs.

Operating at medium steam pressure, with rapid, regular continuous action, the Warrington-Vulcan sinks pile after pile with a moderate frequency of low velocity blows from a relatively heavy ram.

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Chicago 12 ---Illinois

Manufacturers' Activities

Sales—Richard E. Hoagland has been appointed manager of by-products sales of the KAISER CO. INC., with office at 756 South Spring St., Los Angeles 14, Calif. . . . Alvin W. Hicks is sales manager in the St. Louis, Mo., office of MARQUETTE CEMENT MFG. CO. in the Shell Bldg. His territory is Missouri, southern Illinois and southern Indiana. . . . Ralph Lesseig is district sales representative for MCCULLOUGH TOOL CO. in the Rocky Mountain district with headquarters at Casper, Wyo. . . . Gordon V. Millichamp is manager of the New York sales branch of the PENNSYLVANIA RUBBER CO. . . . Robert A. Jackson, structural engineer, is district sales manager for the CHICAGO BRIDGE & IRON CO. at Seattle, Wash. . . . Arthur W. Pugsley has joined the executive staff of the TRUNDLE ENGINEERING CO., Cleveland, Ohio, as vice-president and sales manager. . . . Patrick G. Train is sales manager for the ARCHITECTURAL PORCELAIN CONSTRUCTORS at 2827 Union St., Oakland, Calif. . . . Wm. H. Starbuck is assistant general sales manager of the KELLOGG division of the AMERICAN BRAKE SHOE CO. at Rochester, N. Y. . . . Jack R. Gregson is district sales manager of the WELLMAN ENGINEERING CO. in the eastern territory with offices at No. 2612 Graybar Bldg., 420 Lexington Ave., New York, N. Y. . . . Robinson F. Barker is assistant manager of plate glass sales for PITTSBURGH PLATE GLASS CO. . . . Thos. A. Cantrell is district manager for western New York and Ontario and Quebec for THE EUCLID ROAD MACHINERY CO. . . . John H. Poulson has been appointed regional sales supervisor in the eastern district for EUTECTIC WELDING ALLOYS CORP., makers and distributors of low heat gas and arc-welding rods and fluxes. . . . Wm. J. Carney has been appointed sales manager of the engineered fabrication division of the EDWARD HINES LUMBER CO., at 2431 South Wolcott Ave., Chicago, Ill. . . . C. P. Corrigan has been appointed district sales manager for the Cleveland, Ohio, area of the RAMAPO AJAX division of the AMERICAN BRAKE SHOE CO. . . . Roy S. Rankin, former vice-president and director of sales of HARRIS CALORIFIC SALES, INC., Detroit, Mich., has become manager of the PROGRESSIVE WELDER SALES CO. of Michigan, Maccabees Bldg., Detroit. . . . Alvin W. Hicks, former service engineer in the Memphis, Tenn., sales office of the MARQUETTE CEMENT MFG. CO., has succeeded H. C. Shields, resigned,

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efficient, money-saving
RADIANT HEATING SYSTEMS

Here is detailed, up-to-date information for engineers, architects, and home-builders on the design and installation of efficient radiant heating equipment. This new book covers the subject thoroughly—from a brief outline of physiological reactions to temperature conditions and the basic principles of radiant heat, to step-by-step methods for designing, laying out, and applying radiant heating equipment to all types of building.

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BY RICHARD W. SHOEMAKER
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306 pages
242 illustrations, charts and tables, $4.00

THIS 306-page handbook brings you the authoritative engineering data, and proven techniques . . . the factual information you need to *understand, evaluate,* and use radiant heating to best advantage. It gives specific reasons for the rapidly growing popularity of this modern method of heat control and shows you how to apply it efficiently and economically. Complete with illustrations and schematic diagrams, this book describes currently available equipment—shows how to install it in various types of new and existing buildings—and provides concise explanations and formulas to help you design and specify radiant heating systems to fill any requirements.

CONTENTS

1. General Considerations
2. Advantages
3. Location in Buildings
4. Location in Residences
5. The Radiant Heating Plant
6. Control Systems
7. Design
8. Installation
9. Radiant Cooling
10. Method of Design

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An unrivalled line of attachments is available for the "88-H," "99-H" and Master "99" Power Graders . . . each attachment designed for a type of work ordinarily done by a separate machine. All-Wheel Drive and All-Wheel Steer make it possible to use either a front- or rear-mounted attachment with no sacrifice of operating efficiency, where ordinary graders—handicapped by front-end inertia and lack of rear steer—would be helpless through loss of traction or directional control.

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BUILDERS OF ROAD MACHINERY

Austin Western

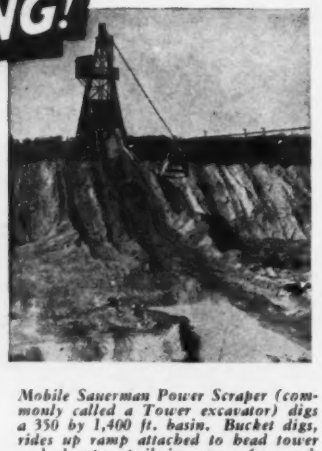
SINCE 1859

FASTER more satisfactory Material Handling at a SAVING!

When you use a

SAUERMAN MACHINE

with one-man control



Mobile Sauerman Power Scraper (commonly called a Tower excavator) digs a 350 by 1,400 ft. basin. Bucket digs, rides up ramp attached to head tower and dumps spoil in cars. 4-cu. yd. bucket handles 200 cu. yds. per hour.

You can be sure of doing a better job of handling any kind of material with these long range machines. The operator requires no special training. Range is flexible . . . operation economical . . . maintenance cost low. Sauerman machines are setting records for long-time service. Some installed 25 years ago are still operating.

Write for Sauerman catalog giving engineering and operational data on all Sauerman machines, and showing typical installations with information on costs.

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by a highly atomized mixture of steam, hot water and cleaning compound applied under pressure through an adjustable spray gun. Mud, muck and grease are removed almost instantly. Hypressure Jenny is portable . . . easy and economical to use. Ordinary labor can operate it. Full-powered, all-purpose, heavy-duty models are available from $388.00 to $555.00.

Hypressure Jenny cleans all types of construction equipment . . . *10 times faster than it can be done by hand.*

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"We save $25.00 on each piece of equipment we clean with Hypressure Jenny."

"Hypressure Jenny steam cleaning helps us locate fractures and trouble on bulldozers before they break down."

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as sales manager at the St. Louis office, 1221 Locust St., for sales in Missouri and southern Illinois . . . S. DeVries has been appointed exclusive sales representative for the new Haiss line of material handling equipment in Connecticut for the GEORGE HAISS MFG. CO., INC., of New York. . . . John F. Flippo, assistant manager of the Pittsburgh district sales office of the ATLAS POWDER CO., has been transferred to Chicago as assistant manager of that district sales office. J. L. Wetzel succeeds Mr. Flippo at Pittsburgh . . . R. E. Stiegele is in the general sales department of the HYSTER CO., Portland, Ore., to handle special sales assignments. He is replaced in the southeastern territory by W. R. Hunt . . . Neal Higgins, manager of sales, INTERNATIONAL HARVESTER industrial power division, has announced these assignments: Jack Bess, formerly zone manager, industrial power sales at Portland, Ore., industrial power manager, northwest region; E. L. Boughton, formerly zone manager, industrial power sales at Boston, Mass., industrial power manager, eastern region; J. D. Gladden, formerly zone manager, industrial power sales at Pittsburgh, Pa., industrial power manager, southern region; W. M. Holland, formerly manager, supply and inventory, industrial power division, industrial power manager, central region; I. P. Payne, formerly manager, Houston, Tex., farm equipment branch, industrial power manager, southwest region; and D. I. Persons, formerly manager Spokane branch, industrial power manager, western region.

Distributors—Two new middle western distributors have been announced by TRACY MFG. CO., Pittsburgh, Pa. They are: APPLIANCE DISTRIBUTORS, INC., 942 North 24th St., Omaha, Neb., and MIDWEST-TIMMERMAN CO., Des Moines and Davenport, Iowa. Eastern representatives are R. U. LYNCH, INC., 9 Federal St., Providence, R. I., and NORTHEASTERN DISTRIBUTORS, INC., 588 Commonwealth Ave., Boston, Mass. . . . E. B. White is representative of PLASTEEL PRODUCTS CO., of Washington, Pa., in Kansas City, Mo., and adjacent territory . . . THE TYSON BEARING CORP. of Massillon, Ohio, has appointed R. A. RODRIQUEZ, INC., 55 West 42nd Street, New York City, as export representative, except for Canada.

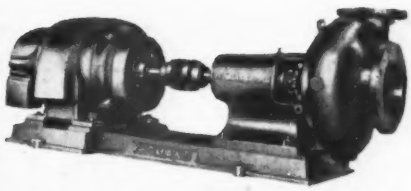
Personalities—S. R. Zimmerman, Jr., has been named director of friction material research and development for RAYBESTOS-MANHATTAN, INC., at the plants at Stratford, Conn.; Manheim, Pa.; Passaic, N. J., and North Charleston, S. C. . . . L. A. Dixon has been appointed vice-president of the meter

and valve divisions of the ROCKWELL MFG. CO., Pittsburgh, Pa. . . . Lorenzo Semple, formerly vice-president of AMERICAN WATER WORKS CO., INC., of New York, has been elected vice-president of the LUSTRON CORP., Columbus, Ohio, which is a new producer of porcelain enamel steel houses. . . . Leonard Florsheim has been named chairman of the board of the INDEPENDENT PNEUMATIC TOOL CO., Aurora, Ill. . . . Dallas S. Casley has been appointed chief engineer of the plant of the PENN METAL CO., INC., at Parkersburg, W. Va., to assist George A. Stevenson, vice-president in charge of operations, in an extensive construction and improvement program. . . . Gustave R. Geiger is now supervisor of quality control of the SKF INDUSTRIES, INC., main plants at Philadelphia, Pa. . . . Clarence W. Winchell, who recently resigned as chief of the BUREAU OF STANDARDS OF NEW JERSEY, has joined the staff of the U. S. TESTING CO., INC., Hoboken, N. J. . . . W. F. Armstrong is the new general manager of the CHEVROLET MOTOR division. He succeeds the late Nicholas Dreystadt . . . Francis H. Miller, Fremont, Ohio, former assistant engineer of Sandusky County, has been named field representative for the PORTLAND CEMENT ASSN. in 25 central and southern Ohio counties . . . G. A. Gilbertson, formerly sales manager of the industrial power division of the INTERNATIONAL HARVESTER CO. has become vice-president of the FRANK G. HOUGH CO., Libertyville, Ill., manufacturers of road building and material handling equipment . . . Paul Brainard is head of the newly-created Hyster engineering standards department of the HYSTER CO., Portland, Ore. . . . John H. R. McDonald, formerly of Glasgow, Scotland, is now general manager of the Home division, KNOX, CORP., Thomson, Ga.

Deceased—Newman Ebersole, 61, director of purchase of ARMCO STEEL CORP., died in Cleveland, Ohio, Sept. 22.

Miscellany—MASONITE CORP. has established five annual competitive college scholarships for children of employes of the hardboard plant at Laurel, Miss. . . . METALLIZING ENGINEERING CO., INC., Long Island City, N. Y., has just celebrated its 50th anniversary. . . . On account of rising manufacturing costs SKF INDUSTRIES INC., is increasing prices on most of its products the rise averaging less than ten percent. . . . J. H. WILLIAMS & Co., Buffalo, N. Y., maker of drop forgings and drop-forged tools has opened a warehouse and sales office in Los Angeles, Calif. at 2266 East 38th St. (Vernon). Charles F. Coates is western district manager at that address.

THREE SIMPLE, FINAL ANSWERS TO "WHAT'S THE BEST WAY TO PUMP SEWAGE?"

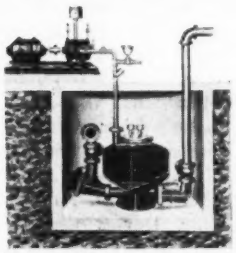


YEOMANS CENTRIFUGAL — *HORIZONTAL*

If an ample dry-pit can be provided, this is the right pump—with pump and direct connected motor on a common bed plate, located to avoid suction lift. Initial cost is low, it is easy to install and maintain. It is rigid, and misalignment in shaft and bearings is virtually impossible.

YEOMANS CENTRIFUGAL — *VERTICAL*

Where possibility of flooding the pit makes it unwise or too costly to install motors and controls, or when deep incoming sewers or other factors limit the size of the pit, the vertical pump is a practical solution. Pumps may be connected by vertical shafts to motors on an upper level; and dry-pit pumps with suction piping to an adjoining collection well is preferable to submerged pumps.



YEOMANS - SHONE PNEUMATIC EJECTOR

Where gallonage of sewage is so small as to make a centrifugal pump physically impractical, where attention and maintenance must be held to a minimum—the world-wide ideal answer is the trusty Yeomans-Shone Pneumatic Sewage Ejector. This famous unit has a 70-year record of efficiency in handling raw sewage and sludge, in municipal systems, urban buildings, industrial plants. It is particularly appropriate where compressed air is used for other purposes.

These three respected units are alike in this: Yeomans designed them and Yeomans builds them — facts which in themselves are sound evidence of thorough engineering and good workmanship. Bulletins on these pumps contain selection tables and helpful engineering data — good literature to have on hand. The coupon makes it easy to get them.

1898 **YEOMANS** 1948
50 YEARS OF PUMP EXPERIENCE

YEOMANS BROTHERS COMPANY
1445 North Dayton Street, Chicago 22, Illinois
Please send bulletins checked:

Yeomans Centrifugal Sewage Pumps — Horizontal and Vertical ☐ Bulletin 6203
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Name .....
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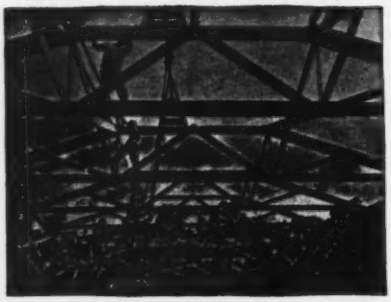
CUT YOUR COSTS IN HALF

with

LANK-TECO Trusses



Such saving has been accomplished by Timber Engineering Company's design of a combination pitch-flat-top roof truss (illustrated)—simple in design, economical, proved superior!

HERE'S WHY

Lank-Teco saves construction costs. Details are simplied so that lay out and fabrication of the trusses is done quickly. You also save up to 50% in materials and hardware with Lank-Teco trusses.

TEST PROOF

of Lank-Teco superiority: under test, a 50' Lank-Teco truss span was loaded to full design load of about 25,000 lbs., for 7 months, which was double the designed for time of loading. Despite the long loading period, results were: deflection only one-half that of similar span flat-top truss also tested. The Lank-Teco truss was overloaded to failure after seven months and carried almost 2½ times design load before failure.

FREE DESIGN DATA

Typical Designs for 40', 48' and 60' spans are available—yours for asking us!

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ENGINEERING COMPANY
WASHINGTON, D. C.

Please send FREE Design Data for size span checked
40' ☐ 48' ☐ 60' ☐

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Men and Jobs

Charles E. Wells, who has been city manager or acting city manager of Albuquerque, N. M., for most of the last 15 years, once again holds the job on a permanent basis. After 14 years as city manager, he quit last October after the city election resulted in a change of control of the city commission. There followed several months of attempts by the commission to hire a new manager. Three men chosen in succession withdrew their applications or quit—one before he had accepted the offer, another after he had been chosen and accepted, and the third after serving nine days as manager. All three blamed politics for their actions. Last January, Wells was named "acting city manager", after it appeared the post would go begging. The city commission now has made the appointment permanent.

Samuel R. Harrison, civil engineer, and a Washington, D. C., employee for 27 years, was promoted to district engineer of streets recently, succeeding **J. N. Robertson,** who is now director of highways. **Leland M. Hedgcock** was named deputy engineer of streets and **Lewis R. Watson, Jr.,** was appointed chief of construction and design.

Robert D. Carpenter, Lansing, Mich., has been appointed planning director for the Fort Wayne, Ind., City Plan Commission, succeeding **George C. Hayward,** who resigned to become executive-secretary of the Citizens Development Committee in Cincinnati, Ohio. Carpenter holds a master's degree in city planning from Massachusetts Institute of Technology. He was associated with Harland Bartholomew, St. Louis planning consultant. During the war he became a lieutenant in the Corps of Engineers and served overseas.

Marvin T. Leeper, for the last five years assistant plant engineer of the American Bridge Co., Gary, Ind., has been promoted to plant engineer, succeeding the late C. J. Kennedy. Mr. Leeper joined the company in 1926 shortly after having been graduated from the University of Arkansas with a B.S. of C.E. degree.

Joseph B. Brooks, B.S. in C.E., Washington University, 1942, has resigned as engineer assistant to the president of the Board of Public Service of St. Louis, Mo., to become civil engineer assistant to his father, Robert B. Brooks, consulting engineer, 1310 Ambassador Building, St. Louis 1, Mo.

Save time and money on CONCRETE CUTTING

• On highways, fine marbles, asphalt, brick, terrazzo, tile, or granite, results are always the same—a smooth finish and perfect 90° angles. One man can operate without previous training. Powerful enough for big jobs—economical enough for small ones. Ideal for scattered work because of ease of transporting — 5 minutes to load and unload and get it working. Let us send you descriptive circular—write

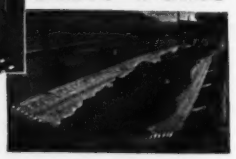
- **quick**
- **accurate**
- **economical**
- **clean**

Backlin STRATEDGE CONCRETE CUTTER

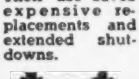
DEALERS Write for information on territories we have open

BACKLIN PRODUCTS CO. BURLINGTON WISCONSIN

KEEP YOUR CONVEYOR BELTS GOING



FLEXCO H D RIP PLATES are used in repairing rips and patching conveyor belts. Their use saves expensive replacements and extended shutdowns.



FLEXCO H D BELT FASTENERS make a strong, tight butt joint with long life. Recessed plates embed in belt, compress belt ends and prevent ply separation. Six sizes in steel and alloys.

• Avoid shutdowns and lengthen the life of your conveyor belts and bucket elevator belts by using Flexco belt fasteners. Thousands of companies have stepped up the performance of conveyor lines and cut costs by using Flexco methods.

Bulletin F-100 shows exactly how to make tight butt joints in conveyor belts with Flexco. Also illustrates step by step the latest practice in repairing rips and putting in patches.

FLEXIBLE STEEL LACING CO.
4656 W. Lexington St., Chicago

Write for your copy.

FLEXCO H-D BELT FASTENERS

Sold by supply houses everywhere

Local Engines Make Good

WAUKESHA ENGINES

• With the "home town folks" there's no distance to lend enchantment. They know what you make, and how you make it. If they use what you make, like what it does for them and how it does it . . . and say so . . . you've got something!

When Mr. E. J. Stephan and Mr. Grover Dobbertin tell you, "For many years Waukesha County has been purchasing road equipment powered with Waukesha Motors" and speak of Waukeshas' "fine performance" it *is* significant. They are the Highway Commissioner and the Chairman of the Highway Committee of Waukesha County.

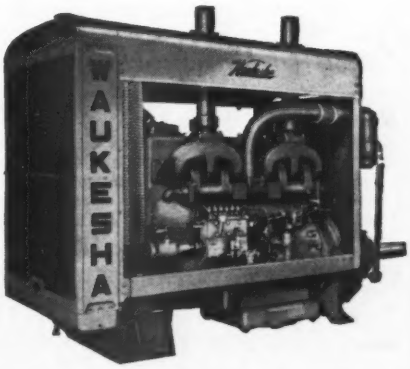
They go on to say: "Most of our large maintenance trucks are equipped with your motors as well as a large power shovel and air compressor. These units have given us very satisfactory results.

"Just recently we purchased one of your LARGE DIESEL POWER UNITS for our new crushing plant and it is proving out far beyond our expectations. One short day we crushed over 600 yds. of gravel, which is about double the production of the unit owned and operated by Waukesha County previous to the installation of the Waukesha Motor Company Diesel . . . The service that you render when needed is superb."

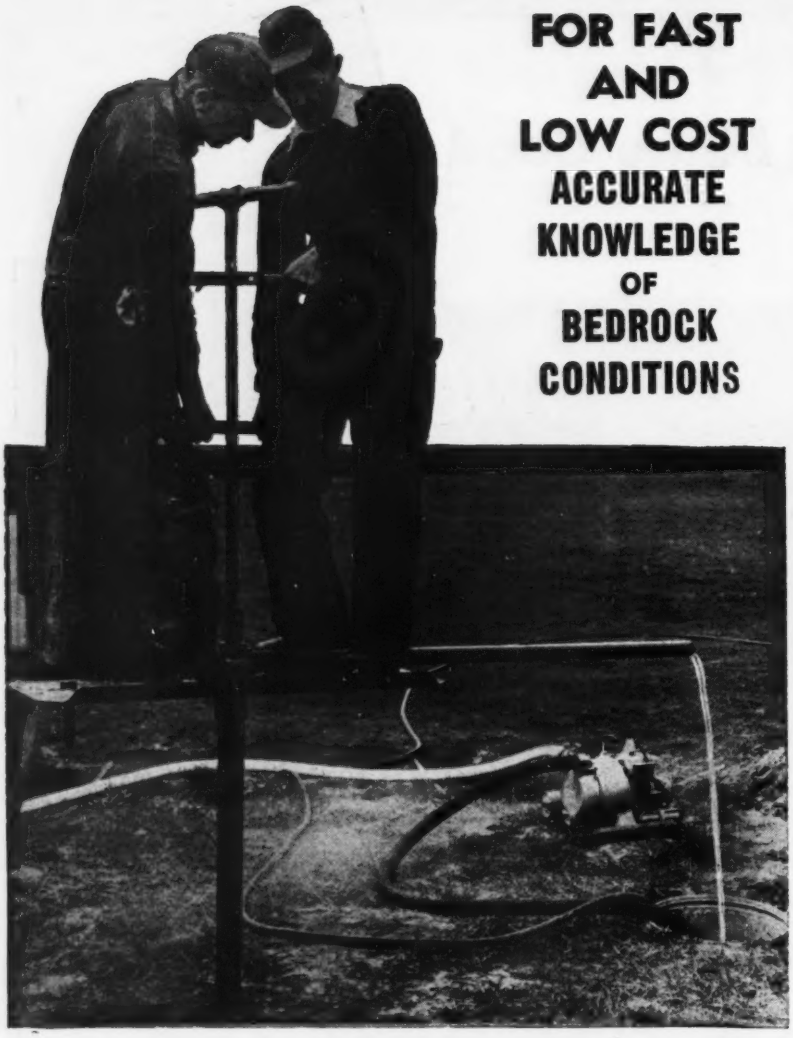
The Diesel unit referred to is the Waukesha Super Duty Diesel. Mounted on its own trailer it is a general utility rig and may be used for any number of applications.

Consult Waukesha engineers on all your power problems. Send for Bulletin 1418.

SUPER DUTY DIESEL Model 6-WAKDU POWER UNIT six cyl., 6¼ in. bore x 6½ in. stroke, 1197 cu. in. displ., 190 hp. max. rating at 1300 rpm.



WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., NEW YORK, TULSA, LOS ANGELES



FOR FAST AND LOW COST ACCURATE KNOWLEDGE OF BEDROCK CONDITIONS

Empire **HYDRAULIC TESTING DRILL**

When you drill to bedrock you want to know your subsurface conditions—but at LOW COST. Here is the rig that you can transport and set up easily and economically in rough country, with a couple of men if necessary. Designed especially for this class of work. Extensively used by U. S. and State Governments and many others. Extremely strong and simple.

Easy to transport, setup, take down

JUST THE DRILL FOR ROUGH COUNTRY

Outfit weighs only a total of 800 lbs. for 50 ft. drilling depths. Gives accurate samples of materials drilled. Every part can be handled by one or two men. Send for descriptive circular giving complete specifications. It will help if you advise us regarding drilling depths and general nature of work.

NEW YORK ENGINEERING COMPANY
75 WEST ST., NEW YORK, N. Y.
Works: YONKERS, N. Y.

Fred F. Loy, Cedar Rapids, is district engineer for Iowa for the Portland Cement Association, succeeding **R. F. Dierking.**

John Burroughs has been re-appointed city engineer of Sapulpa, Okla.

Col. Chester C. Hough, Corps of Engineers, has been named First Army Engineer, General Courtney H. Hodges, Commanding General, has announced. He replaces **Brig. Gen. George J. Nold** who has been assigned as Division Engineer, North Atlantic Division, Corps of Engineers.

A major reorganization of the aqueduct division of the Los Angeles Water and Power Department has placed **Wayne W. Wyckoff,** aqueduct engineer, in charge of the hydrographic field operations of the Inyo-Mono district. **Sydney L. Parratt** became head of the newly-created post of northern district aqueduct engineer. **Robert V. Phillips,** office engineer, has been given charge of field and office engineering, hydrologic field work and engineering laboratory operations. An appointment is to be made soon to the newly-created post of southern district aqueduct engineer. The changes were announced by General Manager Samuel B. Morris, and Chief Engineer of Water Works Laurance E. Goit.

Edward J. Vaughan, West Hartford, Conn., has been appointed inspector of state housing by Administrator Prentice White of the Connecticut State Housing Authority. Mr. Vaughan is classified as a building code engineer and it will be his duty to ascertain if all housing units are built according to plans approved by the authority. Any deviation from specifications will be called to the attention of local housing authorities.

The Pennsylvania Highways Department has announced resignations of engineers on its staff as follows: District No. 4, Scranton, **Paul B. Gilroy,** of Carbondale, project engineer; District No. 5, Allentown, **Ambrose R. West,** of Allentown, assistant district engineer; and District No. 8, Harrisburg, **McClay Gibson,** of Carlisle, resident engineer.

Donald D. Ranger, formerly of Madison, Wis., has been added to the Missoula, Mont., staff of the Public Roads Administration as highway engineer.

Edward E. Hartung has been appointed city engineer at Sandusky, Ohio, succeeding Clarence E. Stockdale. Mr. Hartung had served as city engineer from 1934 to 1941, when he resigned.

34 YEARS Market Street
Savannah, Mo.

29 YEARS East Bridge Street
Oswego, N. Y.

27 YEARS Main Street
Cape Girardeau, Mo.

20 YEARS First Street
Aberdeen, Wash.

Old Streets Resurfaced with CONCRETE

Stand the Test of Time and Traffic

Resurfacing with concrete is a practical way to make durable new pavements of old worn surfaces. This renovation is economical and quickly achieved if the old pavement has a sound base that can be used as a foundation for the new concrete topping.

Concrete resurfacing is also the answer to the problem of strengthening old thin-slab pavements that are no longer adequate for present or anticipated traffic loads. These old, thin slabs often need widening, too. Both jobs can be done simultaneously—at a saving of time, money and inconvenience.

Streets resurfaced with concrete are smooth-riding, strong, durable and economical. Hundreds, like the few shown at the left, have given highly satisfactory service for twenty or thirty years and more. Such streets have all the advantages of new concrete pavements: uniformly high skid resistance, wet or dry; low maintenance cost; greater safety at night due to concrete's light reflectance—highest of all pavement surfaces.

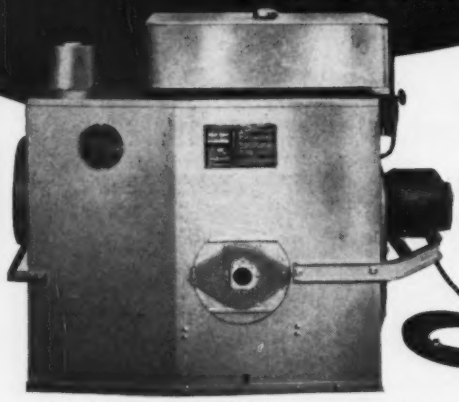
Write today for a free copy of a new illustrated bulletin, "*Concrete Resurfacing for Old Pavements*," which describes many resurfacing projects and contains valuable design data. This booklet is distributed only in the United States and Canada.

PORTLAND CEMENT ASSOCIATION

Dept. 10b-17, 33 W. Grand Ave., Chicago 10, Ill.

A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work

New LOW COST PORTABLE HEAT
FOR YOUR SMALLER JOBS



THE NEW HERMAN NELSON
Economy Model Portable Heater

- **Provides Quick, Clean, Safe Heat — *without* smoke, soot, fumes or open flame!**
- **Abundant *fresh*, heated air — *forced* to areas where most needed!**

Burns range oil, kerosene or prime white distillate—costs but 19c per hour!

125,000 BTU per hour capacity—enough to heat almost two ordinary 5-room houses.

Electric motor powered; 115-230 volt, 60 cycle, single phase.

One 12" dia. x 12' long, extendable hot air duct.

Small, compact, light weight.

LOW PRICED FOR THE SMALLER JOBS!

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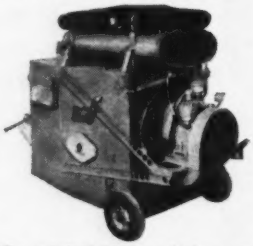

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Elections and Activities

The Interstate Commission on the Potomac River Basin at its recent annual meeting recommended that the U. S. Public Health Service be requested to initiate a sanitary survey of the Potomac River Basin, in cooperation with the states and the commission, to determine more detailed information as to pollution conditions and the best possible location for permanent sampling points on main streams within the area; (2) announced that a cooperative pollution abatement program for the Upper Potomac River area would be undertaken by Maryland, West Virginia, and Pennsylvania; and (3) agreement by the Maryland Water Pollution and the West Virginia Water Commissions to carry out a program for pollution abatement: determine stream conditions; contact municipalities and industries contributing to the badly polluted areas; encourage polluters to take specific steps toward correction of pollution by change in processes and treatment of wastes; and provide for faithful operation of waste treatment facilities. The commission will soon publish a municipal guide, which will be a companion publication to its waste treatment guide, dealing with the treatment of municipal sanitary sewage, and the financing of such projects. The following officers were reelected: Chairman, Raymond V. Long; Vice-Chairman, Harold A. Kemp; Treasurer, Daniel L. Seckinger; General Counsel, Oliver Gasch. Edwin R. Cotton continues as director of the commission.

At the annual convention of the Association of Western State Engineers, held recently in Flagstaff, Ariz., J. J. Walsh, North Dakota State Engineer, was elected president. The 1949 convention of the Association will be held in Bismarck or some other North Dakota city.

At the concurrent annual meetings of the Roadmasters and Maintenance of Way Association and the American Railway Bridge & Building Association, held in Chicago, Sept. 20-22, the following officers were elected. President of the R&MWA, R. L. Fox, division engineer, Southern Ry., Alexandria, Va.; vice-presidents, Neal D. Howard, Western Editor, *Railway Age*, Chicago, and A. G. Reese, district engineer, Chicago, Burlington & Quincy Ry., Galesburg, Ill.

New officers of the ARB&BA are:

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Power shovel built by the Hanson Clutch and Machinery Company, Tiffin, Ohio. Mayari R was used in the boom, lower bed, and upper bed frame.

Hydraulic dump truck built by The Daybrook Hydraulic Corporation, Bowling Green, Ohio. The all-welded body is of Mayari R.

Nobody knows better than the contractor just how much punishment today's construction equipment has to take.

In order to improve the service life and increase the operating efficiency of this machinery, manufacturers are now using low-alloy, high-tensile Mayari R in place of ordinary carbon steel for many critical parts. With such equipment the contractor can count on fewer failures from overloading, less wear from abrasion, reduced deterioration from atmospheric corrosion, and less damage from battering.

Mayari R withstands rougher treatment because it has mechanical and physical properties far superior to those of ordinary structural-quality steel. At only slight increase in initial cost, Mayari R adds substantially to the performance and the value of many types of construction equipment.

Sand and cinder spreader built by the Baughman Manufacturing Co., Jerseyville, Ill. The bed is built of Mayari R.

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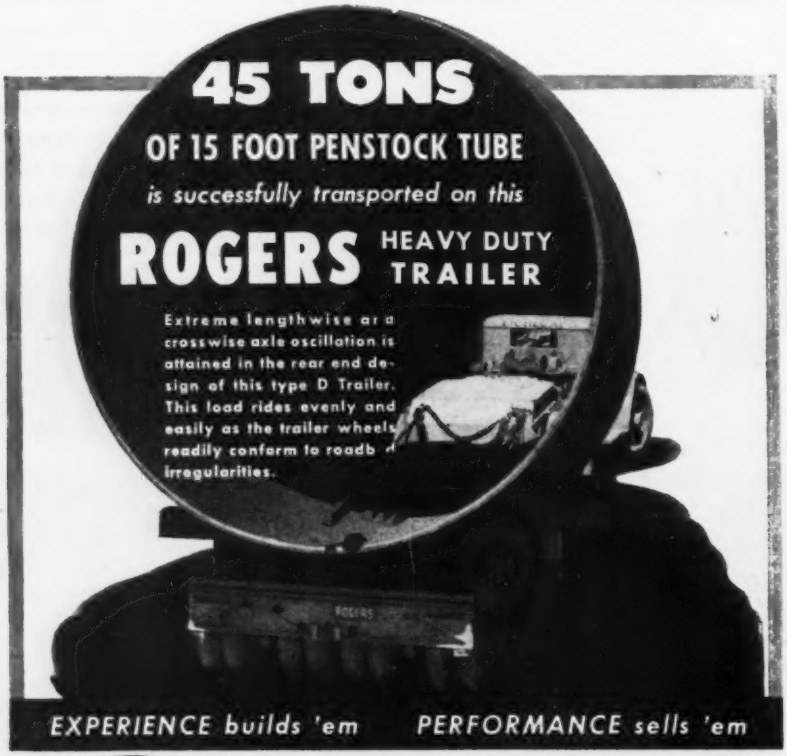
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president, E. H. Barnhart, division engineer, Baltimore & Ohio R. R., Garrett, Ind.; vice presidents, W. F. Martens, general foreman, Santa Fe Ry., San Bernardino, Calif., W. A. Huckstep, general bridge supervisor, Missouri Pacific Ry., St. Louis; Guy E. Martin, superintendent of water service, Illinois Central R. R., Chicago, and F. R. Spofford, ass't. division engineer, Boston & Maine R. R. Dover, N. H. L. C. Winkelhous, architectural engineer, Chicago & North Western Ry., Chicago, was elected treasurer.

An unusual feature of the joint program was a woman speaker, Ruth Terzaghi, geologist, who is consultant to the Association of American Railroads on research into the causes of concrete deterioration. She is the wife of Karl Terzaghi, authority on soil mechanics.

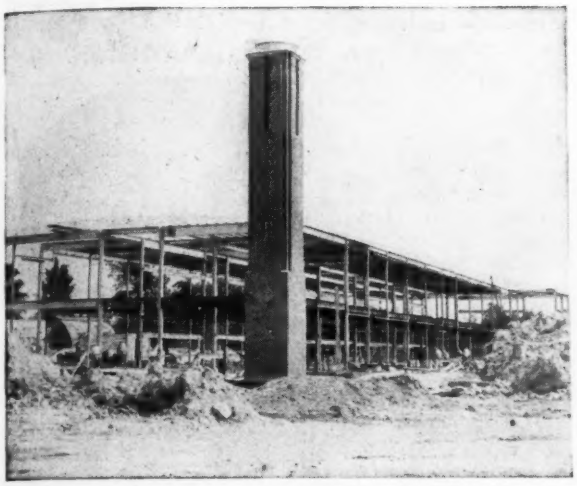
Preceding a meeting of the Engineering Institute of Canada, and the Association of Professional Engineers at St. Andrews, N. B., was a meeting of the EIC council. Austin Wright, Montreal, general secretary of the EIC, contended millions of dollars worth of business has been going to U. S. engineers and manufacturers that should be handled by Canadian engineers and manufacturers. Mr. Wright told of the owner of a Canadian plant having been prevailed on to cancel the order he had given in the U. S. and to use Canadian instead of U. S. engineers. This had resulted in a $5,000,000 contract for Canadian manufacturers. It was pointed out that most U. S. engineers specify U. S. manufacture and equipment. The council decided to approach the Canadian Government again to have the tariff on U. S. plans restored, as a protection for Canadian engineers. The tariff was removed in 1946.

John A. Volpe, Malden, Mass., head of the Volpe Construction Co., has been named vice-chairman of the general convention committee and H. C. Turner, Jr., of the Turner Construction Co., Boston, general convention chairman for the annual convention of the Associated General Contractors of America to be held at the Waldorf Astoria Hotel, New York, February 27, 1949.

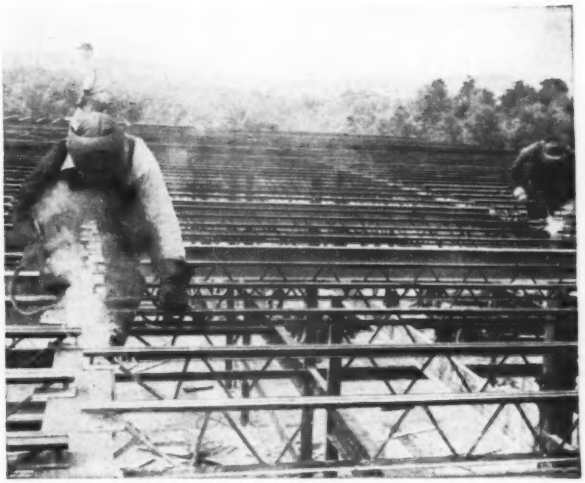
Sixty-nine engineers and scientists, 55 of whom are from Boston, Mass., will receive the President's Certificate of Merit for outstanding service to the armed forces during World War II in joint Army-Navy ceremonies to be held in Boston, Cambridge, Williamstown, Northampton, Mass., and New Haven, Conn.

The first ceremony was held at the University Club, Boston, on Sept. 28, where 15 men were given the certificate, the second highest award to civilians.

Simplifies Erection of School with Arc Welding



19-ROOM JR. HIGH for South Euclid-Lyndhurst, Ohio, schools. Eventually to comprise 25 rooms plus gym. Architects: C. B. Rowley & Assoc.; Structural Engineer: Frank Eroskey & Assoc.; General Contractors: Leo W. Schmidt Co.; Structural Work: Builders Structural Steel Co. (all of Cleveland).



BAR JOISTS of roof are welded to beams with 2″ fillet welds on each side. First and second floor are reinforced concrete. Final building to be 400 ft long with 200 ft. wings. Present part is 210 ft. x 63 ft. plus heating plant.

BEAM-TO-COLUMN connections bolted, plumbed, then arc welded. Total steel in present building 160 tons with columns of 5″ to 8″; beams and girders up to 30″. Welded with 5/32″ and 3/16″ "Fleetweld 5" electrode and portable Lincoln Welders.

WELDED IN 8 DAYS. Two welders completed the welding of the framework in 5 days after members were erected, and welded the joists to the beams in 3 days. The builder reports that arc welding greatly simplified the erection procedure and resulted in an extremely rigid structure.

The above is published by LINCOLN ELECTRIC in the interests of progress. Architects and engineers are invited to write on their letterhead to be placed on mailing list for Structural Welding Studies. The Lincoln Electric Company, Dept. 138, Cleveland 1, Ohio. **Advertisement.**

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Engineering Schools

Faculty Changes

Ralph W. Kluge is now associate professor of structural engineering in the school of civil engineering and engineering mechanics at Purdue University. He will have charge of instruction and research in reinforced concrete. He has a master's degree in civil enginering from the University of Illinois, 1930, and he has done some teaching and research work at that university and at George Washington University, Washington, D. C.

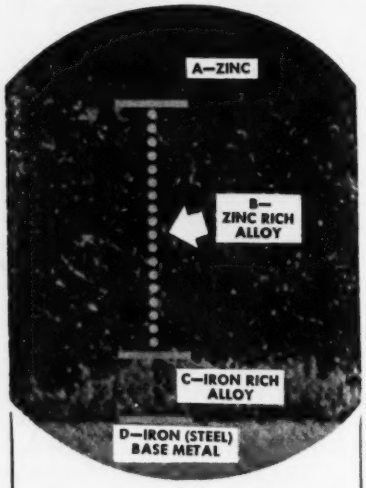
Norman H. Moore, instructor in civil engineering in the school of engineering, The Johns Hopkins University, has resigned to go with the Bureau of Reclamation, Washington, D. C. George S. Benton, formerly on the staff of the department of meteorology of the University of Chicago, has been appointed assistant professor in civil engineering to give courses in physical climatology and hydrology. His assistant will be W. H. Li, who has been employed by the Chinese government in investigating water power development for China. Michel A. Saad, formerly on the faculties of Cornell, University of Texas and North Dakota Agricultural College, has been appointed assistant professor of civil engineering.

At the Michigan College of Mining and Technology professorships have been given to E. J. Townsend, head of the department of engineering administration; and to E. P. Wiedenhoefer of the department of civil engineering.

William L. Everitt, head of the department of electrical engineering, University of Illinois, has been named dean of the college of engineering and director of the engineering experiment station to succeed Dean M. L. Enger who will retire next year.

Reuben N. Bergendoff, of Howard, Needles, Tammen and Bergendoff, consulting engineers, Kansas City, Mo., has been appointed a lecturer in structural engineering at the University of Illinois. Promotions in the department of civil engineering, college of engineering include: C. P. Atkins, instructor to assistant professor; W. J. Austin, special research associate to research associate in structural engineering; E. E. Bauer and G. H. Dell, assistant professors to associate professors; J. C. Guillon, special research associate to research assistant professor of hydraulics engineering; J. G. Seyler, assistant to instructor; J. H. Thornburn, research associate to research assistant professor.

ONLY HOT-DIP GALVANIZING alloys molten zinc to base metal



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For membership roster or any information in regard to *your* particular corrosion problems, address The Secretary, American Hot Dip Galvanizers Association, Inc., First National Bank Bldg., Pittsburgh, Pa.

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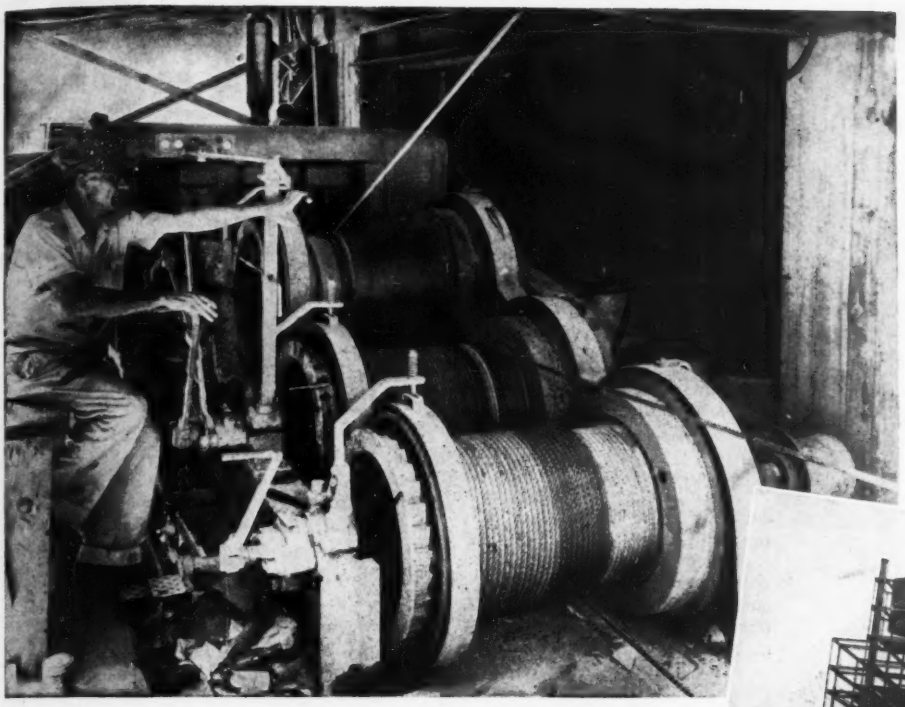

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UNITED STATES STEEL

Richard G. Coulter, a graduate of Syracuse University and resident engineer and specialist in sewage plants and water systems for Holmes, O'Brien & Gere of Syracuse, has been appointed assistant professor of civil engineering at the Cooper Union School of Engineering. New civil engineering instructors are Joseph S. Ward, Jr., Milton Alpern, and Edward D. Ripple.

C. G. Breau has been named acting head of drawing and descriptive geometry in the engineering school at University of New Brunswick.

Douglas W. Miller is the new executive secretary of the Case Institute of Technology, Cleveland, Ohio.

William P. Harrison has been appointed instructor in civil engineering at Clarkson College of Technology, Potsdam, N. Y. He received a degree in mathematics from Dartmouth in 1944 and attended the Thayer School of Engineering before enlisting in the Marine Corps, where he served for three years.

Eugene P. Richey and A. Bert Caseman has been added to the civil engineering staff of Washington State College at Pullman, Wash. Richey has a B.S. degree in civil engineering from the University of Alaska in 1941 and an M.S. in civil engineering from the California Institute of Technology this year. Caseman received his B.S. in civil engineering from Utah State Agricultural College last year.

Raymond A. Skrinde, hydraulics engineer on the General Electric atomic power project at Richland, Wash., has been added to the civil engineering faculty at Washington State College as an assistant professor, while Harry C. Ames, who has taught and practiced engineering in Wyoming, is instructor.

J. Harrison Belknap, former chairman of the University of Rochester division of engineering, has been appointed dean of the graduate section of the U. S. Air Force Institute of Technology at Wright-Patterson Air Base, Dayton, Ohio.

Lorin G. Miller is the new dean of engineering at Michigan State College at East Lansing, succeeding Henry B. Dirks, retired. Dean Miller received his bachelor of science engineering degree at Des Moines University and took advanced study at M.I.T.

Donald R. Lueder, engineer in charge of photo-mapping on the Joint Highway Research Staff, Rutgers University, has recently completed a special study relating soil patterns in aerial photographs to the engineering properties of soils. This work, concentrated on the complex soils of the coastal plains on the eastern seaboard, is a part of the over-all program in photo-analysis being carried on at the Cornell University school of civil engineering.